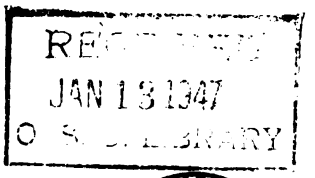
I. C. 7389 NOVEMBER 1946

UNITED STATES
DEPARTMENT OF THE INTERIOR
J. A. KRUG, SECRETARY

BUREAU OF MINES
R. R. SAYERS, DIRECTOR

INFORMATION CIRCULAR

COAL PREPARATION PRACTICE IN WESTERN GERMANY



BY

THOMAS FRASER AND M. G. DRIESSEN

Generated on 2024-09-19 17:23 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

FOREWORD

This report is one of a series written by members of the Solid Fuels Mission to Germany describing wartime developments in the mining, preparation, and utilization of coal. The mission was organized early in 1945 under the auspices of the Technical Industrial Intelligence Committee, which cooperated with a counterpart British Committee. Engineers from other allied countries cooperated in some of the investigations. The Solid Fuels Mission operated under the direction of a steering committee headed by Dr. C. J. Potter, deputy solid fuels administrator. The personnel of the mission consisted of H. F. Yancey, in charge, J. W. Buch, Thomas Fraser, L. L. Newman, and L. D. Schmidt, of the Bureau of Mines; H. H. Lowry, Director of the Coal Research Laboratory, Carnegie Institute of Technology; H. J. Rose, vice president and director of research, Bituminous Coal Research, Inc.; and F. H. Reed, chief chemist, Illinois Geological Survey.

Over 50 reports were written by the members of the Solid Fuels Mission. These and microfilms of supporting data obtained in the course of the investigations are on file at the Bureau of Mines, Washington, D. C. where they are available for public examination. The Office of the Publication Board in the Department of Commerce is prepared to furnish photolith copies, photostats, or microfilm reproductions of all declassified reports. A Bibliography of Scientific and Industrial Reports is issued weekly by the Department of Commerce, Office of the Publication Board, and is sold by the Superintendent of Documents, Government Printing Office, Washington 25, D. C., on a subscription basis. An initial payment of 10 dollars will provide for approximately 9 months, and subscribers will be notified when additional remittance is necessary. All subscriptions will begin with volume 1, No. 1, unless ordered otherwise. The Bibliography covers all materials and subjects and gives instructions for obtaining the desired items.

The reports of the Solid Fuels Mission relate to the following general subjects: Mining methods in the Ruhr district of Germany, with special reference to mechanical cutting and loading equipment, pneumatic packing, and Diesel mine locomotives; activities of industrial research laboratories supported by the German coal and coke industry; coal preparation in western Europe; low-temperature carbonization processes; metallurgical coke from weakly coking coals; low-ash electrode carbon from coal; new developments in the production of metallurgical coke and the utilization of gas and byproducts; briquetting brown coal and bituminous coal without the use of binders; recent engineering developments in gas turbines and steam generators, with special reference to use of coal; German coal-fired heating and cooking stoves; and the commercial extraction of coal with solvents for production of synthetic liquid fuels or chemical products.

Numerous reports on the activities of German synthetic-liquid-fuels plants and the plants for the production of synthesis gas from solid fuels are available in the same office as the Solid Fuels Reports.

It is planned to publish in this series of Information Circulars the more important reports or combinations of reports prepared by the members of the Solid Fuels Mission. A similar series on synthetic-fuel activities is being prepared.

Arno C. Fieldner, Chief,
Fuels and Explosives Branch.

Generated on 2024-09-19 17:23 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

I. C. 7389,
November 1946.

INFORMATION CIRCULAR

UNITED STATES DEPARTMENT OF THE INTERIOR - BUREAU OF MINES

COAL PREPARATION PRACTICE IN WESTERN GERMANY[1]

By Thomas Fraser[2] and M. G. Driessen[3]

CONTENTS

	Page
Foreword.	
Units of measurements	3
Introduction	4
1. Objectives	4
2. Method and scope of investigation	4
Summary	4
3. General practice	4
4. Special techniques and devices	5
General organization of the coal-preparation industry	5
5. General preparation practice	5
6. Jig wash boxes	7
7. Heavy-medium processes	16
8. Summary of general practice	17
9. Special coal-preparation projects	18
Organization of coal-preparation service	18
10. Development and construction	18
11. Standardization of equipment	20
12. Standardization of guarantees	20
13. Price relationships	20
Field data on plants	24
14. Rheinbaben colliery	24
The washery	24
Dewatering fine coal	25
Storage of filter cake	26
15. Augusta Victoria plant	26
Slurry treatment	27
16. Nordstern colliery	28
Heavy-medium washery	29
17. Zeche Carl Alexander	30
Ash extraction	31
18. Zeche Koenigin Elisabeth	32
Electrostatic separators	35

1/ The Bureau of Mines will welcome reprinting of this paper, provided the following footnote acknowledgment is used: "Reprinted from Bureau of Mines Information Circular 7389."

2/ Supervising engineer, Coal Preparation Section, Bureau of Mines, Washington, D. C.

3/ Director of mining research, Dutch State Mines of South Limburg.

Generated on 2024-09-19 17:22 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

CONTENTS (Cont'd)

	Page
19. Preparation of hydrogenation fuel	36
Devices and techniques	36
20. Schieferstein screen	36
21. Wedag counterbalanced vibrating screen	39
22. Wedag Vibratorsichter (deduster)	39
23. Humboldt Rapidsichter (deduster)	40
24. S K B froth breaker	41
25. Discharge of fine coal from bunkers	42
26. Washery-control devices	42
27. Electrostatic separator	43
28. Loading coal into ships	43
29. Büttner rotary kiln dryer	44
30. Turbo dryer	44
31. Aspirator dryer	46
32. Dust collecting	47
33. Büttner pulverizing system	48
Appendix	49

ILLUSTRATIONS

Figure		Following page
1.	Tentative standards for the 3,200 mm. two-compartment wash box	6
2.	Flow sheet of a modern coal washery	8
3.	Experimental overflow-type magnetite suspension washer	16
4.	Tentative screen-size standards	20
5.	Standard drainage pipes for fine-coal bunkers	20
6.	A typical section of the Rheinbaben washery	24
7.	The S K B vacuum filter arrangement	26
8.	Flow sheet of the washery at Augusta Victoria colliery	26
9.	General arrangement drawing of washery at Augusta Victoria colliery	26
10.	Flow sheet of washery at Zeche Carl Alexander	30
11.	Acid-extraction cells at Carl Alexander	30
12.	Flow sheet of the Reinstkohle plant at Koenigin Elisabeth	32
13.	Quantitative flow diagram of Reinstkohle plant at Koenigin Elisabeth	34
14.	The Schieferstein resonance screen	36
15.	Resonance element of the Schieferstein screen	36
16.	Typical stroke-characteristic curve of a resonance screen	36
17.	The Wedag counterbalanced screen	38
18.	Humboldt deduster (Rapidsichter)	40
19.	Performance data on Humboldt deduster	40
20.	Effect of moisture and load on deduster efficiency	40
21.	The S K B froth breaker	40
22.	The S K B sludge bunker	42

Generated on 2024-09-19 17:27 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

ILLUSTRATIONS (Cont'd)

Figure		Following page
23.	Coal-handling equipment at Port of Bremen	42
24.	Barge-loading equipment at Port of Born, Holland	42
25.	Sketch showing function of internal shelves in Büttner kiln dryer	44
26.	Temperature graph of Büttner kiln dryer	44
27.	Büttner turbo dryer	44
28.	Rate of temperature change of turbo dryer	44
29.	Breakage of brown coal in turbo dryer	44
30.	Belt-type turbo dryer	46
31.	Variations in moisture content, by sizes, after drying in turbo dryer - brown coal	46
32.	Progressive drying of brown coal from shelf to shelf in turbo dryer	46
33.	Rate of temperature change in the rapid circulation dryer	46

TABLES

Table		Page
1.	Recent coal-washing practice in the Ruhr	6
2.	Specifications of jig boxes of figure 1	7
3.	Some operating data of a jig washery in the Ruhr	8
4.	Grades of coal produced in the Ruhr in January 1945	21
5.	Some miscellaneous operating costs, including capital costs but not general office overhead	22
6.	Relation of the Reichsmark to the dollar for the purchase of twenty common commodities, January 1945	23
7.	Price schedule of Ruhr coal, by sizes, priced f.o.b. mines, in Reichsmarks per metric ton	24
8.	Typical yields of various grades of pure coal	32
9.	Summary tests of a single-deck resonance screen	37
10.	Performance (monthly average) of Humboldt deduster plant	41
11.	Data of the S K B vacuum froth destroyer	41

UNITS OF MEASUREMENTS

Except where otherwise specifically stated, measurements throughout this report are given in metric units. A list of conversion factors is given below:

1 metric ton	= 1,000 kilograms = 2,204.6 pounds (approximately 1 long ton)
1 kilo	= 1,000 grams = 2.2046 pounds avoirdupois
1 meter	= 3.2407 feet
1 centimeter	= 10 millimeters = 0.3937 inch
1 inch	= 2.54 centimeters
1 kilometer	= 0.62137 mile
1 cubic meter	= 35.3144 cubic feet = 264.17 gallons (U.S.)
1 liter	= 1.0567 quarts (U.S.)

Generated on 2024-09-19 17:23 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Standard sieve sizes are expressed in meshes per square centimeter.

400 meshes per square centimeter = 50 mesh per lineal inch.
10,000 meshes per square centimeter = 250 mesh per lineal inch.

INTRODUCTION

1. Objectives

A study of coal-preparation practices in western Germany was aimed at three main objectives: First, to discover any technological or organizational developments that might be of value to the American coal industry; second, to discover any special devices or techniques that may have been developed in Germany to prepare special grades of coal to meet emergency war needs; and third, to ascertain the grades of fuel and methods of preparation thereof that were particularly adapted to the synthetic-liquid fuels industry. German experience in the last-named field might be of value in the selection and preparation of American coals for conversion to liquid fuels.

2. Method and Scope of Investigation

To facilitate rapid and thorough coverage of technological developments in the field, a preliminary survey contacted the equipment manufacturers and plant builders who service the coal industry. This is a very small group of highly specialized firms that dominates the coal preparation-plant development and construction field. Through the engineering staffs of these firms and the specialists of the Bergbauverein now in the employ of the North German Coal Control Agency at Heisingen, Essen, contact was established with operating plants embodying new developments of promise, so that further field work could be concentrated on those plants. The plants were studied usually in company with technical representatives of the designers and builders.

SUMMARY

3. General Practice

The coal-preparation industry in Germany is organized very much as in America, in that the erection of new plants and extensive alterations are generally handled on contract by specialized equipment manufacturers who also control very largely the exploitation of new technologic developments.

The dominant washer is the jig, which handles 87 to 88 percent of all the coal washed in the Ruhr area. General plant engineering and design does not appear to be as well developed as in American and British practice. Compared to our conditions, at least, the plants are very large and overstaffed in relation to through-put. However, there are some individual items of equipment and techniques that may be adaptable to advantage to American practice. Fine coal jigs (both with and without feldspar) are used almost to the exclusion of other methods for coal under 8 mm. or 10 mm. top size, except the dust under 0.75 mm. is commonly handled by froth flotation.

Generated on 2024-09-19 17:28 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

In the preferred plant design, the 10 x 0 mm. size is dedusted before washing. This appears to be very advantageous in the subsequent dewatering of the coal and clarification of the water.

4. Special Techniques and Devices

Mechanical developments that may be new in part include dedusting devices, flash dryers, conveyor dryers, the resonance screens, froth breakers, and anti-breakage loading devices.

In the field of special preparation for exacting war uses, the Germans devised several intensive coal-purifying methods embracing (1) multiple-stage froth flotation, (2) controlled heavy-suspension separation, (3) electrostatic separation, (4) acid extraction of the ash minerals, and (5) tar-oil extraction of the coal matter. These methods were applied with widely varying success to produce very low-ash coal to serve as a substitute for other carbon materials not available to the Germans. Some of these processes might conceivably be of use to us ultimately for production of low-ash coal for such uses as electrodes for the aluminum industry, for carbide and carborundum industries, for sugar-refinery carbon, and activated carbon.

GENERAL ORGANIZATION OF THE COAL-PREPARATION INDUSTRY

5. General Preparation Practice

The jig washery is the predominant type of plant for the preparation of general industrial coal. Both air-actuated and mechanically actuated jigs are used extensively in current practice. The piston jig box of Coppee type is much more popular in Europe than in America, where the mechanical jig has generally been considered obsolete (except in the anthracite region) since the introduction of the Baum type in the early thirties.

Probably the most striking feature of German practice (and continental practice generally), contrasted with current American practice, is the wide use of jig wash boxes for fine coal. It is standard practice to wash the fine coal of 10 x 0 mm. (0.39 x 0 inch) or 8 x 0 mm. (0.31 x 0 inch) separately on multiple-compartment piston jig boxes, in some instances with feldspar on the screens of the primary washers but generally with a natural slate bed on the rewash boxes. The practice of rewashing the middlings from the fine-coal jigs, on rewash jigs, is general. In many instances the middlings from the nut-coal jigs is crushed and rewashed with the fine-coal middlings or added raw to the fine washed coal. Where the slack is used for colliery power-plant or other local use, the crushed coarse middlings is diverted to that use.

The leading plant builders favor thorough dedusting of the fine coal at approximately ½ mm. before washing. The development of aspirator dedusters has greatly facilitated this practice and has led to a revival of interest in the bin drainage of fine coal as well as in the dedusting practice itself. Complete removal of the dust not only improves the performance of the washers but also greatly increases the rate of drainage of the washed product. There

Generated on 2024-09-19 17:25 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

is now a trend from centrifugal drying back to bunker drainage. Both Klockner-Humboldt Deutz A. G. and Westphalia-Dinnendahl-Groppel A. G. have introduced effective aspirator-type, dry, dedusting systems, and the leading plant builders are introducing specially equipped draining towers into their washery designs.

Most effective dedusting is obtained by following the aspirator dedusters with rinsing sieves that remove the last of the dust from the 8 x 0.5 mm. raw coal before it goes to the jigs. High-speed horizontal or near-horizontal short-stroke shaking sieves are used for this service. With half millimeter-wedge wire cloth, these sieves will handle 8 to 10 mm. top size prededusted coal at the rate of about 8 metric tons per hour per square meter of cloth (0.8 net ton per square foot) and deliver a feed virtually free of dust under 0.35 mm. and less than 1 percent through half millimeter. This practice simplifies clarification of the wash water; hence, new designs incorporate smaller settling cones and thickeners.

The half-millimeter dust is shipped raw, mixed with the washed fines, or cleaned by froth flotation, as conditions may dictate. At the representative plants visited, dry dust was used in the raw state, and only the slurry from the rinsing screens was sent to the flotation plant.

The technique of jigging fine coal is well-developed in Germany, and the adaptability of this system to American practice might well be considered, particularly for use in conjunction with tables or launder washers, as these machines operate on a stratification principle that is complementary to the fundamental jig stratification.

The German and continental coal-cleaning industry has not made use of concentrating tables or rising-current classifiers. The Rheolaveur in modified form has been introduced in a few instances but is not popular.

An estimate of the breakdown of tonnage between the different types of washing plants recently operative in the Ruhr was furnished by Dr. Herman Meyer of the North German Coal Control and is presented in table 1.

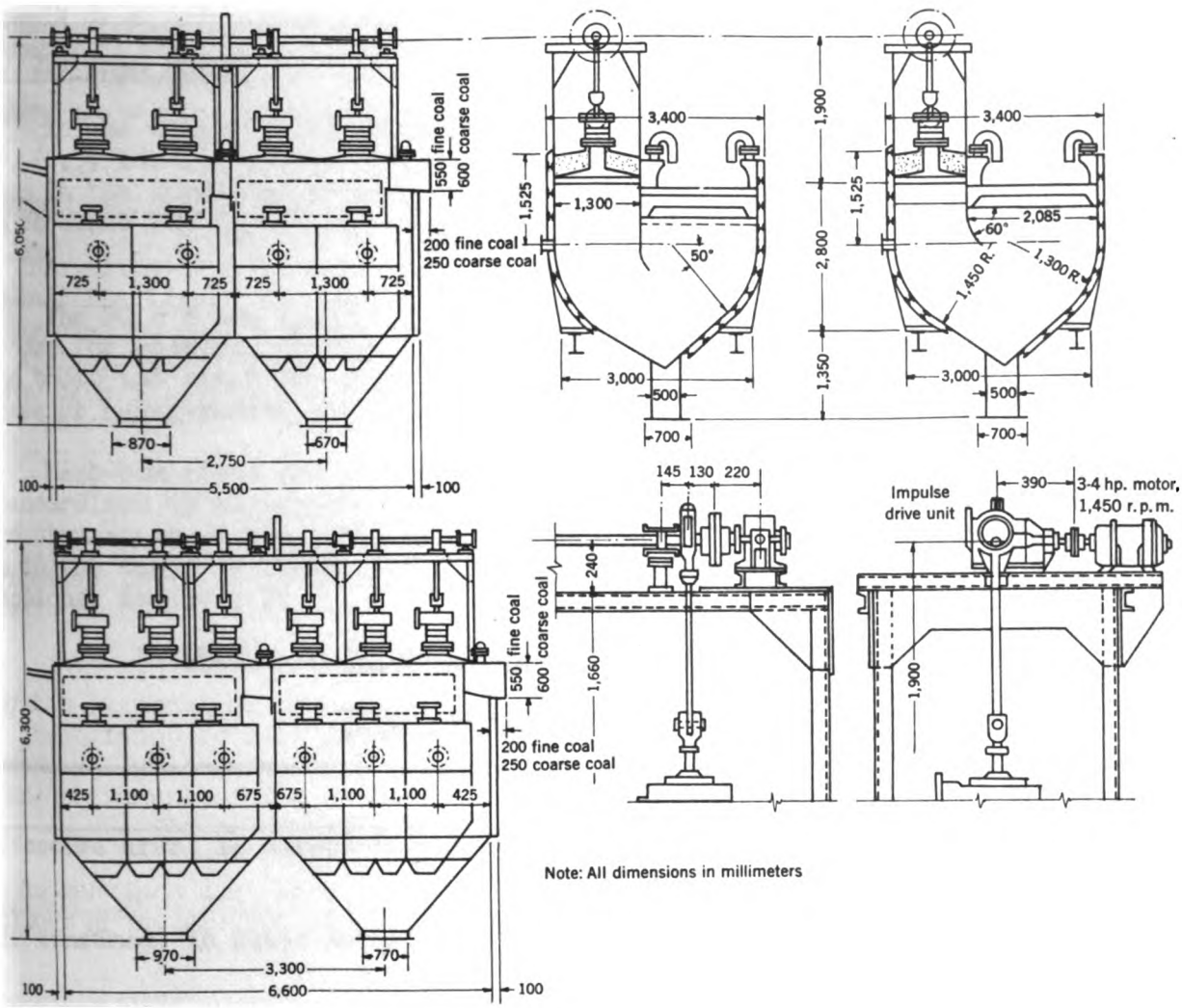
TABLE 1. - Recent coal-washing practice in the Ruhr

Type of washer	Percentages of total tonnage
Jig boxes	87 to 88
Heavy-medium washers	8
Dry cleaners	2 to 3

These data do not include the fines of flotation size. Of this material, about one-third is cleaned by froth flotation, and two-thirds receives no special treatment.

The dry cleaners are of the pneumatic shaking-table type and are reported to be used only for treatment of fine anthracite for briquetting. Small dry-cleaning plants are operated by seven anthracite producers and four briquetting plants.

Generated on 2024-09-19 17:26 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY



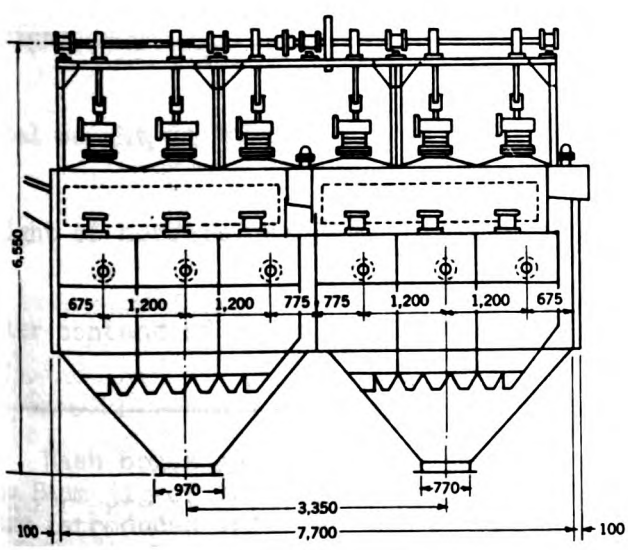


Figure 1. - Tentative standards for the 3,200 mm. two-compartment wash box.

Generated on 2024-09-19 17:20 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from
THE OHIO STATE UNIVERSITY

6. Jig Wash Boxes

In the coarse-coal category (sizes larger than 8 mm. (0.31 inch) or 10 mm. (0.39 inch), washing practice at commercial plants is much more uniform than in the American industry. Lump coal larger than 80 mm. (3.15 inches) is screened out in the head house and hand-picked dry on rubber-belt picking bands.

The 80 x 8 mm. (3.15 x 0.31 inch) size is commonly separated into two grades for washing, either at 30 mm. (1.18 inches) or at 25 mm. (1.0 inch), and these two sizes are washed separately whether the washing is done in jig boxes or heavy-medium separators.

Wash-box sizes and general construction features have tentatively been standardized by agreement among the manufacturers. Figure 1 shows the standard dimensions of the 3,200 mm. two-compartment box. The specifications set up in the table of figure 1 are transcribed, with the corresponding English captions, in table 2.

TABLE 2. - Specifications of jig boxes of figure 1

Width, 3,200 mm. (10 ft. 6 in.)

	Lehgth, mm.	For coarse coal	For fine coal and rewash
Effective area, in square meters	5,500	9.1	10.0
	6,600	11.0	12.3
	7,700	13.2	14.6
Air consumed, in cubic meters per minute	5,500	41	15 (25)
	6,600	49.5	18.5 (31)
	7,700	59.5	22.5 (36.5)
Total weight, in kilograms, cast-iron design	5,500	27,150	26,900
	6,600	32,200	32,000
	7,700	35,500	35,300
Total weight, in kilograms, steel design	5,500	23,150	23,000
	6,600	27,600	27,400
	7,700	30,500	30,000
Weight of hutches, in kilograms	5,500	3,200	3,200
	6,600	4,000	4,000
	7,700	4,800	4,800
Water content of box, cubic meters	5,500	42.00	42.00
	6,600	50.00	50.00
	7,700	57.00	57.00

Wash boxes generally are about the size and general structural design of the Baum jig of the period when the Simon-Carves and Norton-Baum jig designs were introduced into the United States. Development of very large-capacity, heavy, wash boxes that characterized the Americanization of the Baum jig was not paralleled on the continent. Many of the present plants are equipped with cast-iron boxes, but the modern practice is to fabricate the bodies of steel plate by welding.

1299

Generated on 2024-09-19 17:26 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

German jigs are generally equipped with automatic controls of the float type connected to the slate gate-operating mechanism. A modification of this device developed by Schüchtermann and Kremer-Baum A. G. articulates the float movement also with the air valves, so that an excessive accumulation of slate brings about a corrective increase in air impulse on the pulsion stroke.

The same company is now studying the relationship of stroke period and phase characteristics to washer performance with a view to developing more effective use of the jig stroke, such as has been featured by the research at Battelle Institute on the phase characteristics of the air-actuated jig stroke.

Typical data on the through-put and performance of a German Baum jig washery are presented in a table assembled from data provided by Dr. Ernest Dupierry, director of Schuchtermann and Kremer-Baum A. G. These data are presented in table 3. They refer to the flow sheet shown in figure 2.

TABLE 3. - Some operating data of a jig washery in the Ruhr

(See flow sheet, fig. 2)

I. Prescreening

Reference No. and name of operational step	Water, gallons per min.	Solids	
		Tons per hour	Percent
1* Feed to screen, 80 x 0 mm. (3.15" x 0).....	Dry	364.0	100
Coarse coal, 80 x 25 mm. (3.15" x 1").....		91.0	25
Middle, 25 x 10 mm. (1" x 0.39").....		65.0	18
Fine, 10 x 0 mm. (0.39" x 0).....		208.0	57
Total products.....		364.0	100

II. Preparation of nut coal

2. Jig for coarse coal 118 sq. ft., 11 square meters, screen area.			
Feed to jig, 80 x 25 mm.....	2,028	91.0	
(Transport water).....	726		
(Under water).....	1,302		
Washed coal and slurry.....	2,020	59.5	65.5
Middlings.....	2	6.5	7.0
Refuse.....	6	25.0	27.5
Total products.....	2,028	91.0	100.0
Crushing and sizing middlings			
Middlings screen:			
25 x 10 mm.....		4.2	65.5
10 mm. x 0.....		2.2	34.5
Total crushed middlings.....		6.4	100.0

* Numerals refer to machine numbers on flow sheet, fig. 2.

Generated on 2024-09-19 17:26 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Generated on 2024-09-19 17:22 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

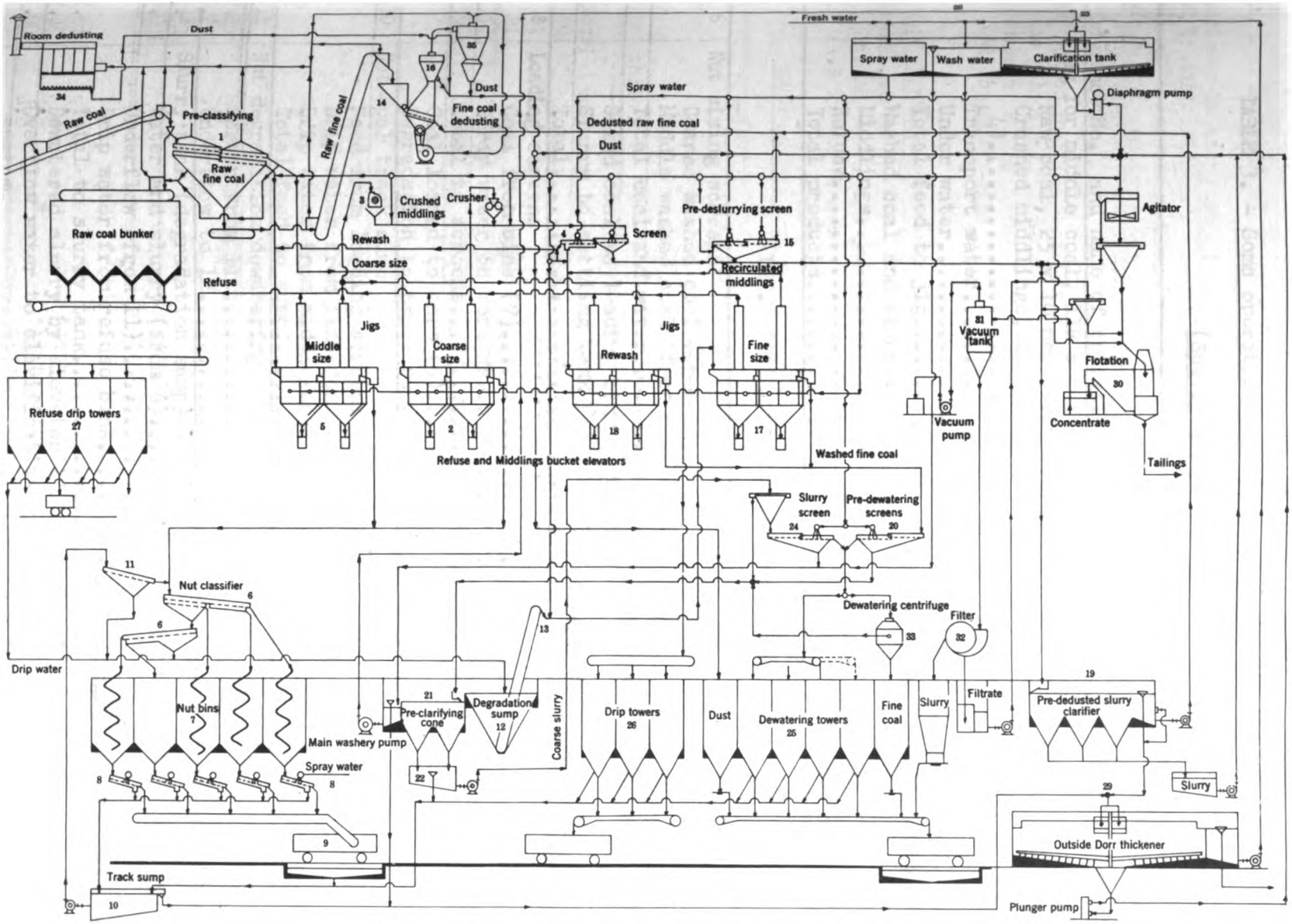


Figure 2. - Flow sheet of a modern coal washery.

Digitized by Google
Original from THE OHIO STATE UNIVERSITY

TABLE 3. - Some operating data of a jig washery in the Ruhr

(See flow sheet, fig. 2) (Cont'd)

Reference No.	and name of operational step	Water, gallons per min.	Solids Tons per hour	Solids Percent
5	Jig for middle coal, 118 sq. ft.			
	Raw coal, 25 x 10 mm. (from 1)		65.8	94.0
	Crushed middlings, 25 x 10 mm. (from 4)	2	4.2	6.0
	Transport water	528		
	Under water	1,162		
	Total feed to jig	1,692	70.0	100.0
	Washed coal and slurry	1,683	54.5	78.0
	Middlings	4	5.5	8.0
	Refuse	5	10.0	14.0
	Total products	1,692	70.0	100.0

III. Sizing and loading nut coal

6	Nut sizing screens			
	Coarse washed coal (from 2)	2,020	60.0	52.0
	Middle washed coal (from 5)	1,683	54.0	48.0
	Total coal and water	3,703	114.0	100.0
	Sized coal to loading bins (7)	22	106.0	93.2
	Slurry to settling tank (12)	3,681	8.0	6.8
	Total	3,703	114.0	100.0
8	Loading screens			
	Coal from bins (7)	22	106.0	
	Spray water on screens	211		
	Total to screens	233	106.0	
	Coal loaded to cars (9)	26	103.0	
	Degradation to track sump (10)	207	2.6	
10	Nut-coal track sump			
	Feed from loading screens (8)	207	2.6	
	Drip water from fine-coal bins (25)	113		
	Drip water from middle-coal bins (28)	8		
	Total feed to sump	328	2.6	
11	Nut degradation dewatering			
	Screen from 11	328	2.6	
	Underflow to 12	328	2.6	
12	Slurry tank (degradation sump)			
	Water and slurry (from 6)	3,681	8.0	
	Underflow (from 11)	326	2.6	
	Drip water from refuse bins	7		
	Total to slurry tank	4,014	10.6	
	Dewatered slurry by elevator 13	8	6.6	
	Overflow water to clarification system	4,006	3.7	
	Total products	4,014	10.3	

Generated on 2024-09-19 17:21 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

TABLE 3. - Some operating data of a jig washery in the Ruhr

(See flow sheet, fig. 2) (Cont'd)

IV. Fine-coal dedusting and desliming

Reference No. and name of operational step		Water, gallons per min.	Solids: Tons per hour	Solids: Percent
14	Fine coal deduster			
	Raw 10 x 0 mm. coal (from 1)		207	
	Dedusted product to desliming screen 15		166	
	Dry dust to classifer 16		41	
	Total products		207	
	Above estimated on basis of 21.5 percent 0.5 x 0 mm. dust in feed and deduster performance at 4 percent moisture of 80 percent removal of dust with 16 percent of oversize in the dust product.			
15	Desliming sieve			
	Feed coal from deduster (14)		166	
	Transport water	994		
	Spray water, dirty	176		
	Spray water, fresh	154		
	Total feed to screen	1,324	166	
	Oversize deslimed coal 10 x 0.5 mm. to jig (17)	198	148.0	
	Through product raw slurry and water to cones (19)	1,126	17.0	
	Total	1,324	165.0	

V. Fine-coal preparation

17	Fine-coal jigs, 2 @ 131.4 = 262.8 sq. ft.			
	Deslimed raw coal (from 15)	198	148.0	
	Degradation from slurry tank (12)	9	6.6	
	Transport water	792		
	Underwater	1,945		
	Total feed to jigs	2,944	154.6	
	Washed coal and slurry to 20	2,920	133.0	86.2
	Middlings to rewash jig (18)	13	9.4	6.0
	Refuse	11	12.0	7.8
	Total products	2,944	154.4	100.0
18	Rewashing fine coal, fine-coal rewash jig, 96.9 sq. ft.			
	Middlings from fine-coal jigs (17)	13	9.4	
	Transport water	66		
	Fines, 10 x 0.7 mm., from crushed nut middlings screen (4)	53	5.5	

Generated on 2024-09-19 17:25 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

TABLE 3. - Some operating data of a jig washery in the Ruhr

(See flow sheet, fig. 2) (Cont'd)

Reference No.	and name of operational step	Water, gallons per min.	Solids Tons per hour	Solids Percent
	Transport water	22		
	Underwater	783		
	Total feed to rewash jig	937	13.9	
	Washed coal and slurry to 20	921	2.4	16.0
	Middlings to 26	13	9.5	64.0
	Refuse to 27	3	3.0	20.0
	Total products	937	14.9	100.0
	VI. Treatment of middlings			
4	Middlings screen			
	Crushed middlings from coarse-coal jig 2	2	6.4	
	Transport water	110		
	Crushed middling from middle coal jig 3	4	5.5	
	Transport water	110		
	Spray water, dirty	66		
	Spray water, clear	53		
	Total feed to screen	345	11.9	
	25 x 10 mm. size to middle coal jig 5	.2	4.2	
	10 x 0.7 mm. to rewash jig 18	53	5.5	
	0.7 x 0 mm. to settling tank 19	290	2.2	
	Total products	345	11.9	
	VII. Dewatering fine washed coal			
20	Fine-coal dewatering sieves			
	Coal and water from fine-coal jig 17	2,921	131.1	
	Coal and water from rewash jig 18	921	2.4	
	Wash water, clean	154		
	Total to screen	3,996	135.5	
	Dewatered fine coal	154	121.0	
	Underflow slurry and water to 21	3,842	14.5	
	Total screen products	3,996	135.5	
	VIII. Water clarification and sludge recovery			
21	Washed-coal water preclarifying cones 21			
	Overflow from slurry tank 12	4,006	3.7	
	Underflow of fine-coal dewatering sieve 20	3,842	14.5	
	Total feed to cones	7,848	18.2	

Generated on 2024-09-19 17:23 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

TABLE 3. - Some operating data of a jig washery in the Ruhr

(See flow sheet, fig. 2) (Cont'd)

Reference No. and name of operational step		Water, gallons per min.	Solids	
			Tons per hour	Percent
	Thickened slurry to pump sump (22)	97	12.1	
	Overflow water and slime to clarification 23	7,751	6.1	
	Total products	7,848	18.2	
24	Slurry sieves			
	Thickened slurry from pump sump 22	97	12.1	
	Clean spray water	88		
	Dewatered coarse slurry	9	5.5	
	Fine slurry and water	176	6.6	
	Total	185	12.1	
25	Fine-coal draining towers			
	Dewatered fine coal from sieves 20	154	121.0	
	Coarse slurry from slurry sieves 24	9	5.5	
	Total to towers	163	126.5	
	Drained washed coal (9.0 percent moisture)	50	126.5	
	Drip water to track sump 10	113		
	IX. Dewatering middlings and refuse			
26	Middlings-drainage bins			
	Washed middlings from rewash jig 18	13	9.5	
	Drained washed middlings (12 percent moisture)	5	9.5	
	Drip water to track sump 10	8		
27	Refuse draining bins			
	Refuse from coarse coal jigs 2	6	25.0	
	Refuse from middle coal jigs 5	5	10.0	
	Refuse from fine coal jigs 17	11	12.0	
	Refuse from rewash jigs 18	3	3.0	
	Dewatered refuse (8 percent moisture)	18	50.0	
	Drip water to degradation sump 12	7		
	X. General water clarification and storage			
23	Main thickener and clarifier			
	From washed-coal water-clarifying cones 21	7,751	6.1	
	Underflow from slurry sieves 24	176	6.6	
	Overflow to wash-water storage tank 28	7,788		
	Thickened sludge to flotation	139		

Generated on 2024-09-19 17:22 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

TABLE 3. - Some operating data of a jig washery in the Ruhr

(See flow sheet, fig. 2) (Cont'd)

XI. Distribution of wash water

Reference No. and name of operational step	Water, gallons per min.	Solids	
		Tons per hour	Percent
Transport water to move feed to coarse-coal jig 2	726		
Water introduced under screens	1,302		
Transport water to carry feed to middle coal jig 5	528		
Water introduced under screens	1,162		
Spray water to fine-coal desliming screen 15	176		
Transport water to move feed to fine-coal jig 17	792		
Water introduced under screens	1,945		
Transport water, crushed middlings 2 to screen 4	110		
Transfer water, crushed middlings 5 to screen 4	110		
Spray water to crushed middlings screen 4	66		
Transport water, fine middlings to rewash jig 18	66		
Transport water, crushed middlings to jig 18	22		
Water introduced under jig screens	783		
Total	7,788		
19 Prededucted slurry clarifier			
Water and slurry from predesliming sieve 15	1,126	17.6	
Water and slurry from crushed middling sieve 4	291	2.2	
Total to cones	1,417	19.8	
Transport water returned to desliming sieve 15	994		
Thickened sludge	247	15.4	
Overflow water to thickener 29	176	4.4	
Total	1,417	19.8	
29 Thickener (outside)			
Overflow from settling cone 19	176	4.4	
Thickened sludge	26	4.4	
Clarified water	150		

Generated on 2024-09-19 17:26 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

TABLE 3. - Some operating data of a jig washery in the Ruhr

(See flow sheet, fig. 2) (Cont'd)

XII. Flotation of sludge

Reference No. and name of operational step		Water, gallons per min.	Solids	
			Tons per hour	Percent
30	Flotation machine			
	Thickened sludge from main thickeners 23	138	12.8	
	Thickened sludge from predesliming fine coal 19	247	15.4	
	Thickened sludge from outside thickener 29	26	4.4	
	Dry dust from deduster 16-34-35		11.4	
	Filtrate water from 32	220		
	Fresh water	73		
	Total to flotation	704	44.0	
	Concentrate (clean coal)	255	34.3	78.0
	Refuse	449	9.7	22.0
	Total	704	44.0	100.0
32	Filter			
	Floated coal from 30 through froth breaker 31	255	34.3	
	Filter coke (20 percent moisture)	35	34.3	
	Filtrate water	220		

XIII. Recap of coal distribution to products

	Washed nut coal		103.6
	Washed fine coal		126.7
	Filter cake (froth flotation product)		34.3
	Dry dust		29.8
	Middlings		9.5
	Refuse		59.6
	Total		363.5

XIV. Dewatering of fine coal by centrifuge

33	Centrifugal dryer			
	Dewatered fine coal	154	121.2	
	Coarse slurry	9	5.5	
	Centrifuged coal (7 percent moisture)	37	122.3	
	Effluent water	126	4.4	
	Total water	163	126.7	
23	Main thickener (with centrifuge operation)			
	Overflow of settling cones 21	7,763	10.6	
	Underflow of slurry sieve 24	176	6.6	
	Overflow to wash-water tank 28	7,788		
	Thickened sludge to flotation	151	17.2	

Generated on 2024-09-19 17:27 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

TABLE 3. - Some operating data of a jig washery in the Ruhr

(See flow sheet, fig. 2) (Cont'd)

Reference No. and name of operational step	Water, gallons' per min.	Solids Tons per hour	Solids Percent
30 Flotation machine			
Thickened sludge from 23	151	17.2	
Sludge from settling cones 19	247	15.4	
Sludge from outside thickener 29	26	4.4	
Dry dust from deduster 16-34-35		7.0	
Water from filter 32	228		
Fresh water	51		
Total to flotation	704	44.0	
Concentrate (floated coal)	264	35.2	80.0
Refuse	440	8.8	20.0
32 Filter			
Floated coal from 30 through 31	264	35.2	
Filter cake	35	35.2	
Effluent water filtrate back to 30	229		

XV. Recap of products (with centrifuge operation)

Washed nut coal		103.6	
Washed fine coal		122.3	
Filter cake (floated coal)		35.3	
Dry dust		34.3	
Middlings		9.5	
Refuse		58.7	
Total		363.7	

XVI. Fresh-water distribution and disposal

Water going out of plant		Fresh water introduced	
With tower drainage of fine coal			
With nut coal	26	At nut-coal loading screens	211
With fine coal	50	Predesliming fine raw coal	154
With filter cake	35	Middlings screen	53
With middlings	5	Fine washed-coal dewatering sieve	154
With coarse refuse	18	Slurry screens	88
With flotation reject	449	Flotation	73
Outside thickener overflow	150		
Total	733	Total	733
With centrifugal dewatering of fine coal			
With nut coal	26	At nut-loading screen	211
With centrifuged fine coal	37	Predesliming fine coal	154
With filter cake	35	Middling screen	53
With middlings	5	Fine washed-coal dewatering sieve	154
With coarse refuse	18	Slurry screens	88
With flotation tailings	440	Flotation	51
Thickener overflow	150		
Total	711	Total	711

Generated on 2024-09-19 17:20 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

With regard to cleaning performance, it is impossible to make a direct appraisal of German and continental jigging practice in relation to American standards, because in Europe emphasis is on the yield side, whereas in Americ it is more on the product side. This will be evident from a study of the examples of plant-performance guarantees presented in the Appendix. Tested at normal washing gravities, the refuse will be relatively freer from float coal and the washed product will carry more sink material than corresponding operations in America. Comparison is further complicated by the practice, much more common in Europe than in America, of producing a middling product.

It is the general opinion of the investigators that jigging operations in Germany are not significantly different in cleaning efficiency from American practice, although sufficient specific test data were not assembled to substantiate this opinion by factual proof. Leaders of the equipment industry expressed the view that in the past decade jig practice had been improved by a reduction of the tolerance of ash in the cleaned coal from 1½ percent above the float-coal ash at the same yield to a tolerance of around 0.5 to 0.8 percent above the float coal ash at the same yield; and that this improvement has been brought about primarily by better plant engineering and by improvements in operational and control techniques.

However, examination of representative plants did not bring to light any important developments in the field of control, such as automatic sampling, product testing, or control routine. In fact, the plants visited, which were represented to be modern, well-designed plants representing the best practice, are not as well-equipped as the best American plants in this respect.

Any appraisal of this comment with regard to the washed product must take into consideration the conditions noted above -- that in European practice the economic emphasis is on yield. In coarse-coal jig plants producing commercial coal, the slate end probably will be guaranteed to contain less than 1 percent of float material.

7. Heavy-Medium Processes

The practice of heavy-medium separation in Germany has generally followed the trends developed by the Dutch. The first commercial plant using the Barvoys process was erected at the Sophia Jacoba Colliery near Hückelhoven in the Aachen field in 1933. For this reason, it is called the Sophia Jacoba process in Germany. Several additional plants have been installed in Western Germany by Westphalia-Dinnendahl-Groppel A. G. The Tromp process first used at the Dominixale Colliery in South Limburg is being introduced into Western Germany by two of the equipment manufacturers: Schuchterman and Kremer-Baum and Klöckner-Humboldt-Deutz A. G.

These processes have been well-described and explained in the technical literature.

In German plants, heavy-medium separation boxes have been introduced into conventional jig-plant designs without any substantial revision of general

Generated on 2024-09-19 17:25 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

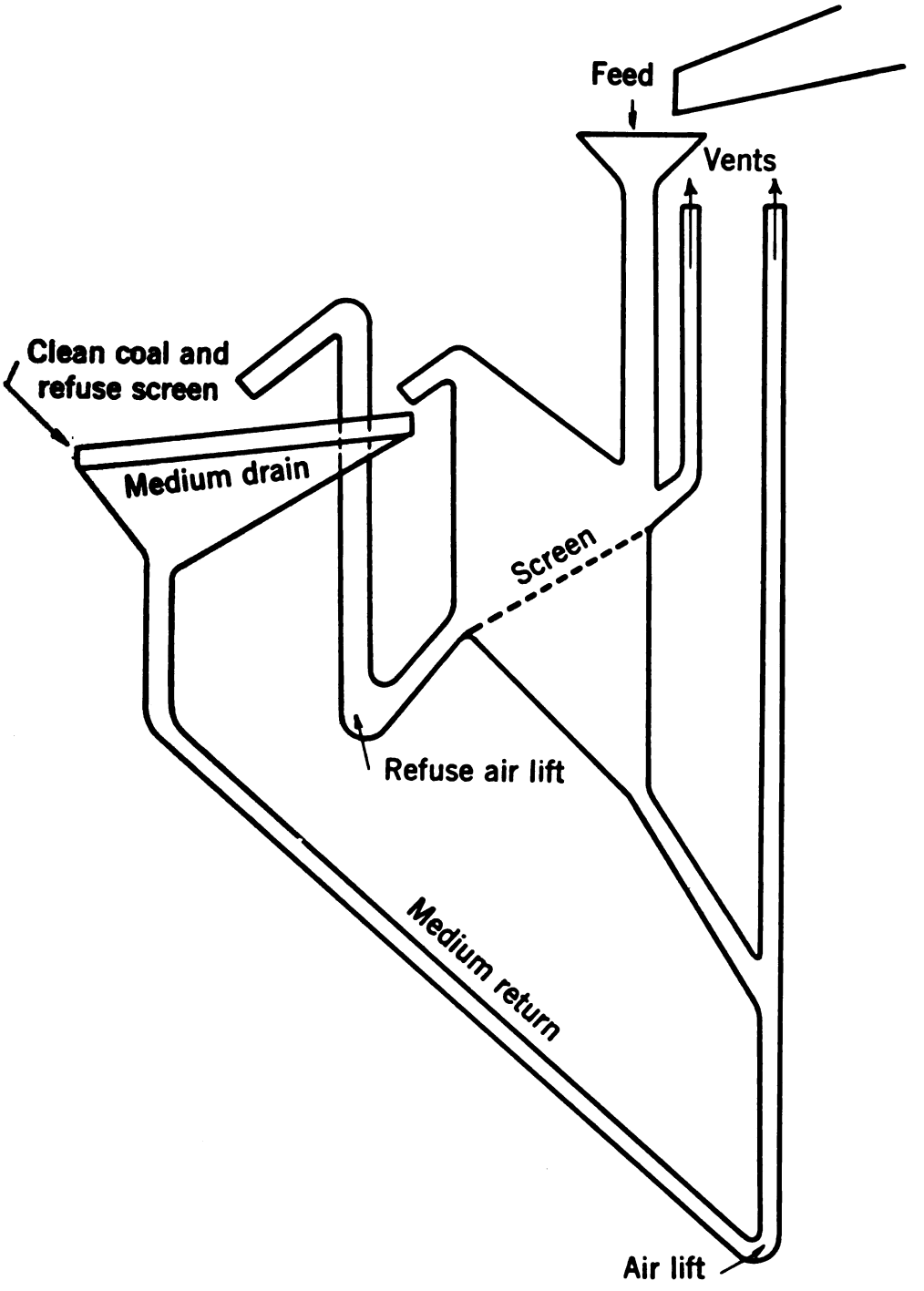


Figure 3. - Experimental overflow-type magnetite suspension washer.

Generated on 2024-09-19 17:25 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from
THE OHIO STATE UNIVERSITY

plant arrangement. The coarse coal adapted to heavy-medium separation is divided into two size-grades, just as in jig practice (80- x 25-mm, and 25- x 8-mm.), and these two sizes are washed separately, then rinsed, sized and loaded through bunkers to transportation facilities.

The Chance Sand Flotation process is not used in Germany, and there is no evidence of an acknowledged influence of the long-standing American experience in heavy-medium separation in German or continental practice.

Developments in this field have been concentrated on the use of substantially "stable" suspensions, such as the barytes-clay mixture of the Sophia Jacoba process, in which the medium settles only very slowly and on processes using unstable suspensions but adapted to compensate for a predetermined and presumably uniform settling rate by control of the characteristic of the return suspension material.

In these latter processes, pulverized magnetite has been used; but, curiously, the potential advantages of magnetic recovery and reconditioning of the medium have been ignored, at least up to the time of the experimental installation in the special Reinstkohle plant at Koenigin Elisabeth Colliery. This may have been due to a lack of effective magnetic separator equipment. At Koenigin Elisabeth, a machine somewhat like the Kings was installed by Krupp-Gruson A. G. This is referred to later in the description of the Koenigin Elisabeth plant.

At the works of Klöckner-Humboldt Deutz A. G., a research project is now being carried on to develop a magnetite suspension washer of the overflow-discharge type, which appears to follow, more nearly than any other European development, the trend of American practice in the use of heavy suspensions. The general idea of this apparatus is shown in figure 3.

The Germans apparently have contributed little to perfecting heavy-suspension concentrating processes. This general method of gravity separation pioneered in America by Chance, Conklin, and Wuensch, with the early development and reduction to practice of the Chance Sand Flotation process, was then given a revolutionary turn to the use of substantially stable suspensions by the Dutch with the development of the Barvoys process, the Staatsmijnen Loess process, and the Tromp process; and these processes have probably reached their best development, from the standpoint of plant design and control, in British practice.

8. Summary of General Practice

To summarize the comparison of contemporary German and American coal-preparation practices, there is (1) the greater preponderance of conventional jig washers in the German field (although the Baum jig is also the most popular washer in America), (2) presizing of coal before jigging, as compared to almost universal practice of jigging unsized coal in America, (3) treatment of fine coal on jigs in Germany, contrasted to use of tables, launders, and classifiers in America, (4) extensive use of froth flotation in Germany, (5) wide use of the Chance sand flotation process in America, with no direct

Generated on 2024-09-19 17:22 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

counterpart in Germany but with a more definite trend there to the use of substantially stable suspensions, (6) loading of the product through bins in Germany, compared with the practice of direct continuous loading of prepared grades from preparation units to transport facilities in American practice. These differences in practice apply in large measure to continental practice generally.

There is little material evidence of interchange of ideas and methods between the coal preparation industries of continental Europe and America in the past.

9. Special Coal-Preparation Projects

Aside from the preparation of coal for general industrial and commercial use, several special coal-preparation projects of interest have been undertaken primarily as a result of emergency war conditions.

Those projects center around the preparation of supercleaned coal products for very special purposes, such as the production of carbon electrodes for the aluminum industry, generator fuel for automotive vehicles, and coal adapted to be converted into liquid fuel.

The most exacting specification is for the electrode coal, which must be of substantially less than 1 percent ash content. To produce coal of this grade, the first step was always the selection of seams that would respond most effectively to supercleaning. Schemes for ultrarefining of the coal, most of which were still in the development stage at the end of the war, included (1) multiple-stage froth flotation, in which the froth product was repeatedly reflocated until the ultimate end point of ash reduction was reached substantially without regard to the yield, (2) attempts at ultrarefinement of heavy suspension processes represented by the laminarstrom washer, (3) electrostatic separation, (4) acid extraction of the ash-forming minerals, and (5) use of solvents to extract the coal matter.

Such ultracleaning schemes actually were incorporated into only three commercial plants. All of these were bombed and are not now in condition to be operated. Such data as could be obtained regarding the technological functioning and the performance of these plants is given in some detail in the fifth section of this report, designated "Field Data."

ORGANIZATION OF COAL-PREPARATION SERVICE

10. Development and Construction

The development of coal-preparation technology and the construction of plants is very largely in the hands of a few contracting firms that service the industry in much the same way as the American equipment manufacturers service the coal industry of America. The principal builders of coal-preparation plants are:

Generated on 2024-09-19 17:23 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

1. Schüchtermann und Kremer-Baum A. G., with factories in Dortmund and Herne, Ernst Dupierry, managing director. This firm manufactures a complete line of screens, wash boxes, dedusters, and conveyors for handling coal and builds complete coal-handling and preparation plants on contract. This firm has the German license for the Tromp process but shares the field with Klockner-Humboldt-Deutz A. G., of Cologne.

2. Westphalia-Dinnendahl-Gröppel A. G., with works in Bochum and Dinnendahl, Dr. Mollenberg and Carl Gröppel, directors. This firm likewise manufactures a complete line of coal-handling, screening, and washing appliances with patented dedusters and auxiliary devices. It is the German licensee of the Barvoys process, designated the Sophia Jacoba process in the German trade.

3. Klockner-Humboldt-Deutz A. G., Cologne-Kalk, Dr. Ernst Maruhn, director. This firm manufactures ore-dressing as well as coal-preparation appliances, briquetting plants, and general coal-handling equipment. It holds a license to sell Tromp magnetite-washing plants, and it is one of three firms associated in a syndicate to manufacture the Schieferstein resonance screens. The other two firms are Krupp-Gruson A. G., Magdeburg, and Carlshutte Maschinen und Stahlbau Gesellshaft m.b.H., Waldenburg-Altwasser. The latter two firms, in the Russian zone of occupation, were not visited, but some engineers formerly on their staffs were interviewed at their Essen office.

J. Pohlig A. G., Cologne and Demag, Duisburg, are leaders in the installation of cranes and bridges for handling coal over tidewater piers.

Buttner-Werke A. G., Uerdingen, is especially active in the development of dryers adapted to use in the coal-preparation industry. These dryers are incorporated into the designs of the coal-preparation and handling plants.

In Germany, it is the most common practice to handle the erection of new preparation plants and extensive alterations of existing plants by contract with one of these recognized firms specializing in that line, which customarily tender firm bids on a competitive basis.

The contractor undertakes manufacture and erection of equipment, buildings, and supplementary facilities usually on a fixed lump-sum basis with performance guarantees. He places the plant in operation and turns it over to the customer in operation after an acceptance test has been completed. In this regard, contracting practice is virtually identical with American practice.

The manufacturers are active, also, in the development of new equipment and techniques. Developments initiated at producers' plants likewise find their way into general use through the agency of the appliance manufacturers, who furnish the only practical means by which new devices can be reduced to practice and introduced to the general trade.

Generated on 2024-09-19 17:26 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

11. Standardization of Equipment

As a step to minimize confusion and misrepresentation in the solicitation of contracts and the formulation of guarantees, the principal contracting firms have tentatively agreed upon standard designs and specifications for certain items of preparation-plant equipment. Copies of tentative dimension sheets of such items as have presently been standardized are reproduced in figures 1, 4, and 5, from sample sheets obtained from Schuchtermann und Kremer-Baum A. G. These include standard designs of wash boxes, screens, and draining-bin standpipes.

12. Standardization of Guarantees

Through the agency of the Bergbauverein, a comprehensive scheme for the standardization of the plant-performance guarantee has been proposed. In this plan, which has been published in a schedule entitled "Richtlinien für Abnahme und Überwachung von Steinkohlen-Aufbereitungsanlagen," issued by the Bergbauverein forms are suggested for guarantees of the performance of washeries, screens, and filters.

Tolerances are not prescribed, but examples of generally acceptable performance with respect to typical operating conditions are presented. A transcript of the salient parts of this document are reproduced in the Appendix.

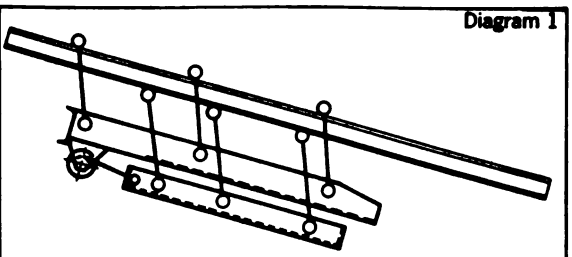
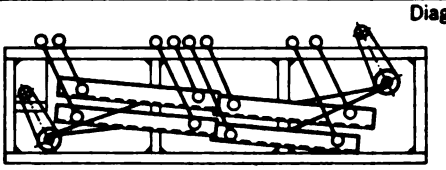
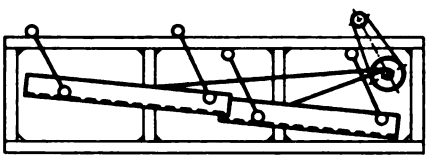
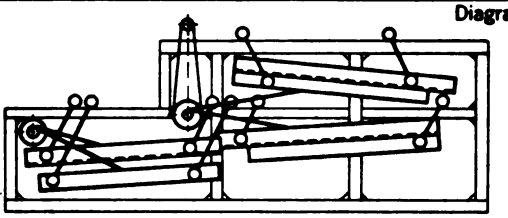
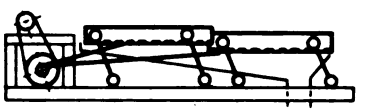
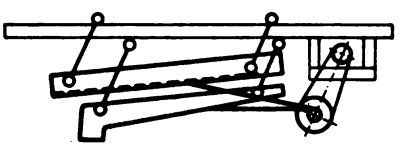
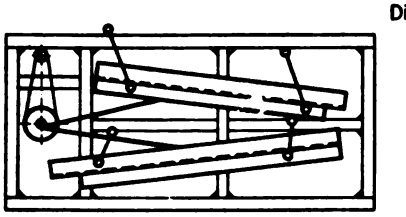
13. Price Relationships

This investigation was strictly a technological project. There was neither time nor facilities to study the economic relationships affecting the German coal-preparation industry; yet it is difficult to make an intelligent appraisal of technologic practices, particularly as to the features that differ radically from our own practice, without some knowledge of a few simple and fairly ascertainable factors that affect the practical operation of the industry.

Such factors as the prevailing price of coal, the wage rate, relative prices of other basic commodities, availability of competitive fuels, and the wartime demand for special and strategic forms of the product may readily rationalize otherwise unexplainable peculiarities of technology.

In wartime Germany, the coal industry supplies three grades of coal refined beyond the normal industrial grade. A schedule showing the technical names, ash specifications, uses, and prices as of January 1945 of these grades and the ordinary industrial grade, as well, is presented in table 4.

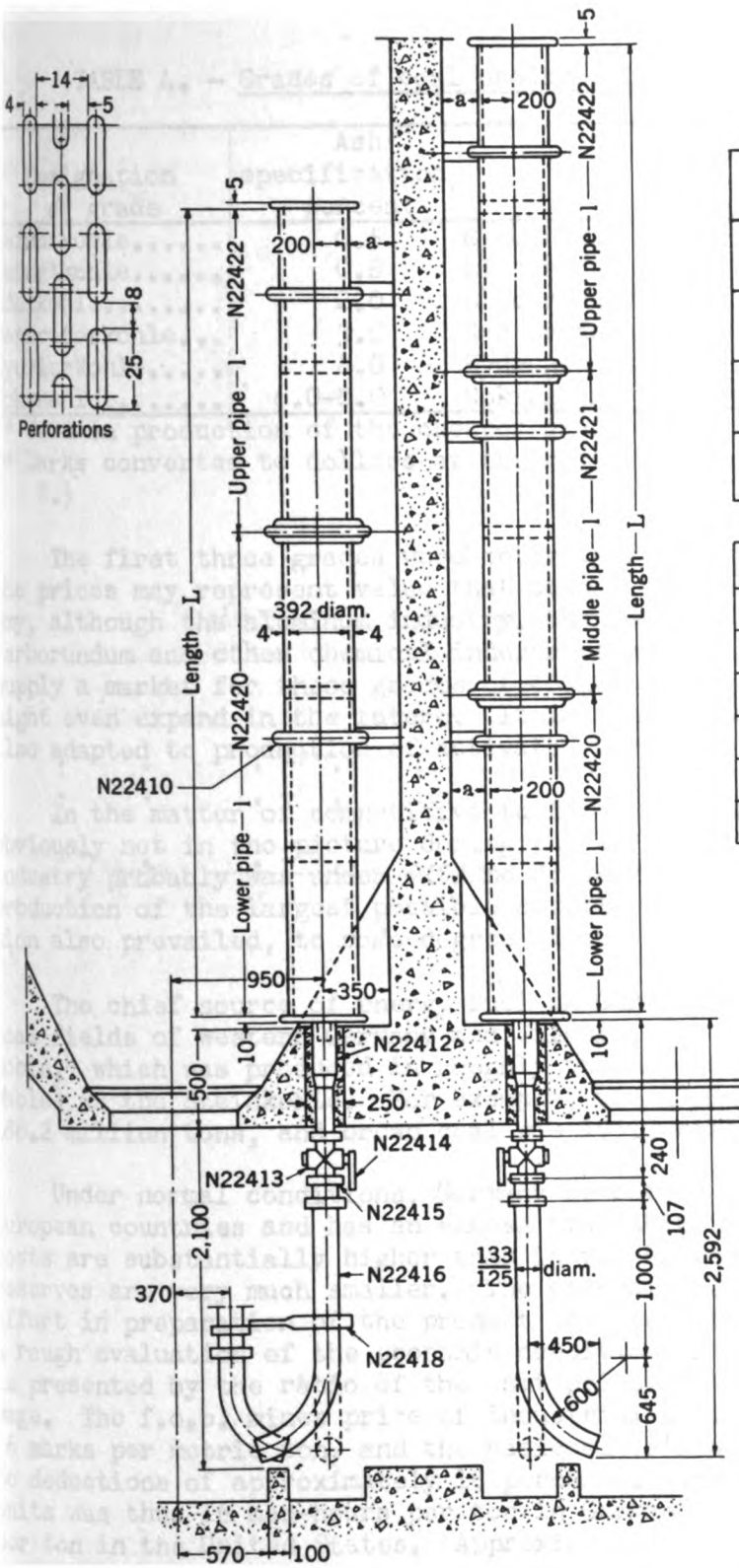
Generated on 2024-09-19 17:28 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Run of mine coal screen	Diagram 1 
Preclassifying screen 1,600 = 2 4,000 1,800 = 2 4,000 2,000 = 2 4,000	Diagram 2 
Nut classifying screen (small capacity) 1,400 x 7,000 1,600 x 7,000 1,800 x 7,000 Screens under the drive 1,600 x 2 2,500	Diagram 3 
Nut classifying screen 1,400 x 9,000 1,600 x 9,000 1,800 x 9,000	Diagram 4 
Fine coal and predeslurrying screen 1,200 = 2 2,500 1,400 = 2 2,500 1,600 = 2 2,500 Slurry screen 1,000 = 2 2,500 1,200 = 2 2,500 1,400 = 2 2,500	Diagram 5 
Nut loading screen 1,400 x 3,000 1,600 x 3,000	Diagram 6 
Coke screen 1,000 x 4,500 1,400 x 4,500 1,600 x 4,500	Diagram 7 

Note: All dimensions in millimeters

Figure 4. - Tentative screen size standards.

Generated on 2024-09-19 17:29 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY



	Length l	Weight in kilograms
N22422 Upper pipe	3,000 2,500	107 86
N22421 Middle pipe	3,000 2,500	109 89
N22420 Lower pipe	3,000 2,500	114 93
Pipe solid ends	500	18

Cased pipe	N22412	32
Valve	N22413	29
Valve handle	N22414	0.9
Nipple	N22415	15
Drain pipe	N22416	24
Pipe support	N22418	28
Pipe holder	N22410	ga. 10

Note: - All dimensions in millimeters.

1. The total length L of the drainage pipe is whole or half meter rounded sections.
2. The pipe drainage lengths are selected to be 2,000; 2,500; 3,000; 3,500 and 4,000 mm.
3. With drainage pipes of 3 m. and longer, 2 stiffner rings are provided

In the part list given:

4. Specify length l as measurement of individual drainage sections.
5. Number of pipe holder rings and measurement a.

Figure 5. - Standard drainage pipes for fine-coal bunkers.

Generated on 2024-09-19 17:28 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

TABLE 4. - Grades of coal produced in the Ruhr in January 1945

Designation of grade	Ash specification, percent	Use	Price per metric ton f.o.b. mine	
			Reichmarks	**Dollars
Reinstkohle.....	0.5	Electrodes	107	40.66
Reinstkohle.....	0.8	Electrodes	95	36.10
Edelkohle.....	2.0	Electrodes*	55	20.90
Generatorkohle...	3.0	Gas producers	34	12.92
Hydrierkohle.....	4.0	Hydrogenation	24	9.12
Kokskohle.....	6.0-8.0	Coking and industrial	16	6.08

* Used in production of the cheaper grades of aluminum.
** Marks converted to dollars at the rate of 38 cents per mark. (See table 6.)

The first three grades were entirely strategic products, and presumably the prices may represent value that cannot be maintained in a peacetime economy, although the aluminum industry, the sugar-refining industry, and carbide carborundum and other chemical industries may be expected to continue to supply a market for these grades of coal. It is conceivable that this market might even expand in the future. It is reported that the cleanest coal is also adapted to production of activated carbon.

In the matter of competitive fuels, petroleum and natural gas were obviously not in the picture during the war, but, on the contrary, the coal industry probably was under extreme pressure to furnish raw material for production of the largest possible supplies of synthetic oils. This condition also prevailed, to some degree at least, before the war.

The chief source of energy fuel in Germany, other than the bituminous coal fields of western Germany and Silesia, was the brown coal or "Braunkohle," which was produced in roughly the same volume (for Germany as a whole) as the Steinkohle. For example, the 1938 production of Steinkohle was 186.2 million tons, and brown coal was 195.0 million tons.

Under normal conditions, Germany is better supplied with fuel than other European countries and has an excess available for export, but production costs are substantially higher than in the United States, and the available reserves are very much smaller. The expenditure of a substantially greater effort in preparation of the product and prevention of waste is justified. A rough evaluation of the economic condition of the coal-producing industry is presented by the ratio of the unit price of the product to the prevailing wage. The f.o.b. mines price of industrial coal in the late war years was 16 marks per metric ton, and the basic miner's wage was 8.40 marks (subject to deductions of approximately 18 percent). The price of coal in labor units was thus 16 man-hours per ton in Germany, compared to about 2 man-hours per ton in the United States. Approximately the same relationship prevailed in the pre-war years, as there was little variation in basic commodity prices and wage rates under the rigid price-control system prevailing in Germany during the war.

Generated on 2024-09-19 17:26 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Very little attention was given to monetary cost data in this investigation, as the wide differences in commodity price patterns in Germany and in the United States under the influence of war conditions and artifically controlled prices would make it very difficult to evaluate such data expressed in German price units. However, some miscellaneous cost figures were obtained and they are presented here for what they may be worth to the reader.

The tentative dollar equivalent shown in the table was arrived at by using a value of 38 cents for the mark. This factor was obtained by comparing estimates of prevailing American prices and German prices of a list of 20 commodities. The estimate of prices was prepared by Dr. Joseph Becht, an interpreter in the FIAT office and was verified by Dr. J. Nusslein, formerly a director of I. G. Farben A. G., both residents of Frankfurt. A transcript of this tabulation is given in table 6. This is a hastily arranged and unscientific statistical appraisal of the dollar value of the mark. It is presented only as an explanation of the manner of arriving at the dollar equivalents of the cost data of table 5.

TABLE 5. - Some miscellaneous operating costs, including capital costs but not general office overhead

Operation	Reichsmarks	Dollars
Cost per ton:		
Washing1/.....	0.25-0.42	0.095-0.16
Froth flotation and filtering1/...	1.00-2.00	.38 - .76
Cost per liter of aero-benzin:		
Hydrogenation2/.....	.20- .22	.076- .084

1/ Costs of washing and flotation by Dr. Meyer of Bergbauverein given as typical of Ruhr practice.

2/ Cost of conversion to aero-benzin at Gelsenberg Benzin A. G.

Generated on 2024-09-19 17:22 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

TABLE 6. - Relation of the Reichsmark to the dollar for the purchase of twenty common commodities, January 1945

Item	Price in the United States in dollars	Price in Germany in Reichsmarks	Ratio, cents to Reichsmarks
1 loaf bread (1,000 grams)	0.15	0.35	43
1 dozen eggs	.60	3.00	20
1 kilo sugar	.10	.80	12.5
1 kilo meat	.80	1.80	44
1 kilo potatoes	.045	.10	45
1 kilo cabbage	.03	.15	20
1 glass beer	.10	.30	33
1 kilo butter	1.00	3.50	30
1 package (20) cigarettes	.14	1.20	12
1 pair shoes	6.00	25.00	20
1 cotton shirt	2.25	11.00	20
1 haircut	.75	.80	94
1 call by doctor	4.00	10.00	40
1 admission to motion picture show	.35	1.50	23
1 streetcar fare in big city	.08	.20	40
1 100-kilometer railway fare	1.34	4.00	31
1 hour's work as laborer	.65	0.72-1.10	65
1 domestic servant's monthly wage	60.00	50.00	120
1 month's rent on workingman's house in city (3 rooms)	30.00	80.00	37.5
1 ton (1,000 kilos) coal (retail)	11.00	110.00	10
			760.0

Note. - Average value of the reichsmark for these items is $\frac{760}{20}$ = 38 cents.

The relation of price to size of the standard grades of coal is shown in the schedule of prices of the Rheinisch-Westfälisches Kohlen-Syndikat shown in table 7. These prices were published in August 1938, but virtually no change took place during the war period.

Generated on 2024-09-19 17:27 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

TABLE 7. - Price schedule of Ruhr coal, by sizes, priced f.o.b. mines, in Reichsmarks per metric ton

Trade name and size, mm.	Price per ton		
	Fett coal, 18-29 percent volatile matter	Ess coal, 12-18 percent volatile matter	Anthracite No. 1, 7-11 percent volatile matter
Raw resultant 80 x 0	12.90	12.00	-
Run-of-mine	14.00	13.00	-
Lump over 80	18.25	18.25	19.00
No. 1 nut, 80 x 50	17.00	19.00	27.00
No. 2 nut, 50 x 30	17.00	19.00	31.00
No. 3 nut, 30 x 18, 20 x 15	17.00	19.00	25.00
No. 4 nut, 20 x 10, 18 x 12	16.85	17.00	18.50
			18.00
No. 5 nut, 10 x 6, 8 x 5	16.00	16.00	15.00
Washed fines, 5 x 0	12.50	12.25	11.25
Raw fines, 5 x 0	12.00	12.25	11.25
Coking slack	15.00	-	-

FIELD DATA ON PLANTS

14. Rheinbaben Colliery.

This is one of several operations of Hibernia Bergwerksgesellschaft, a state-owned colliery company. The Rheinbaben pit near Bottrop has a rated capacity of 5,000 tons of coal per day (16 hours). The product is a medium-volatile bituminous coal (27 percent volatile matter) divided into two use classes, i. e., "Gaskohle"4/ and "Fettkohle"4/, which are handled separately in preparation but by identical methods.

The preparation plant is a design of Schüchtermann und Kremer-Baum A. G., erected in 1939. It consists essentially of a sizing plant and a washing and loading plant in which the two grades of coal are washed by parallel Baum jig washing plants of 200 tons per hour rated capacity for the "Gaskohle" and 150 tons per hour for the "Fettkohle." The preparation plant is housed in steel and masonry buildings of permanent construction. Colliery and preparation plants are undamaged and were in full-scale operation at the time of inspection.

The operating force in the washing plant is 35 men on each shift.

The Washery

A typical section of the preparation plant is shown in figure 6. This is sheet 1 of a series of six assembly drawings covering the entire plant. The complete set is available in the files of the Bureau of Mines, Washington, D. C.

4/ The Ruhr classification of coals according to volatile matter is: Gasflammkohlen, 35 to 40 percent; Gaskohlen, 30 to 35 percent; Fettkohlen, 19 to 30 percent, Esskohlen, 13 to 19 percent; and Anthrazitkohlen, 8 to 12 percent. (Ruhrkohlen Handbuch.)

Generated on 2024-09-19 17:27 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

List of equipment in figure 6.

Ref. No.	Item
1	Raw-coal feed
2	Raw-coal bunkers
3	Raw-coal return conveyor
4	Raw-coal bucket elevator
5	Raw-coal preclassifiers
6	Raw fine-coal bin
7	Bucket elevator
8	Coarse dust separator
9	Fine dust separator
10	Conveyors to coking-coal bins
11	Room dedusters
12	Ventilator
13	Predeslurrying screen
14	Blower for Baum jigs
15	Coarse-coal jigs
16	Coarse-refuse elevator
17	Coarse-middlings elevator
18	Fine-coal jig
19	Fine-refuse elevator
20	Fine-middlings elevator
21	Fine-middlings elevator
22	Fine-coal jig
23	Fine-refuse elevator
24	Fine-middlings elevator
25	Rewash jig
26	Refuse elevator
27	Recirculating elevator
28	Middlings elevator
29	Recirculating elevator
30	Refuse belt conveyor
31	Refuse belt conveyor
32	Refuse belt conveyor
33	Dust belt conveyor
34	Dust belt conveyor
35	Dust belt conveyor
36	Middlings conveyor
37	Steam-coal elevator
38	Steam-coal conveyor
39	Fine-coal degradation sump
40	Fine-coal elevator
41	Nut-coal degradation sump
42	Degradation coal elevator
43	Centrifugal dryer
44	Dried-coal elevator
45	Dried-coal conveyor
46	Predeslurrying clarifier
47	Wash-water clarifier
48	Flushing-water sump
49	Water drainage pipes
50	Slurry-discharge hopper
51	Dust belt conveyor
52	Dust belt conveyor
53	Coarse-slurry sump
54	Coarse-slurry pump
55	Wash-water pumps
56	Fine-slurry sump
57	Flotation-slurry pump
58	Pumps to predeslurrying screens
59	Degradation-sump pump
60	Raw-slurry cone
61	Diaphragm pumps
62	Flotation cells
63	Compressed airline for concentrators
64	Vacuum tank for the froth destroyer
65	Thickener for slurry water
66	Slurry filter
67	Vacuum pump
68	Dried slurry tank
69	Dried slurry feeder
70	Clear water tank
71	Ground water sump
72	Ground water pump
73	Gravel bed
74	Electric switch room
75	Transformer room
76	Office
77	Supply room

Generated on 2024-09-19 17:25 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Generated on 2024-09-19 17:26 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

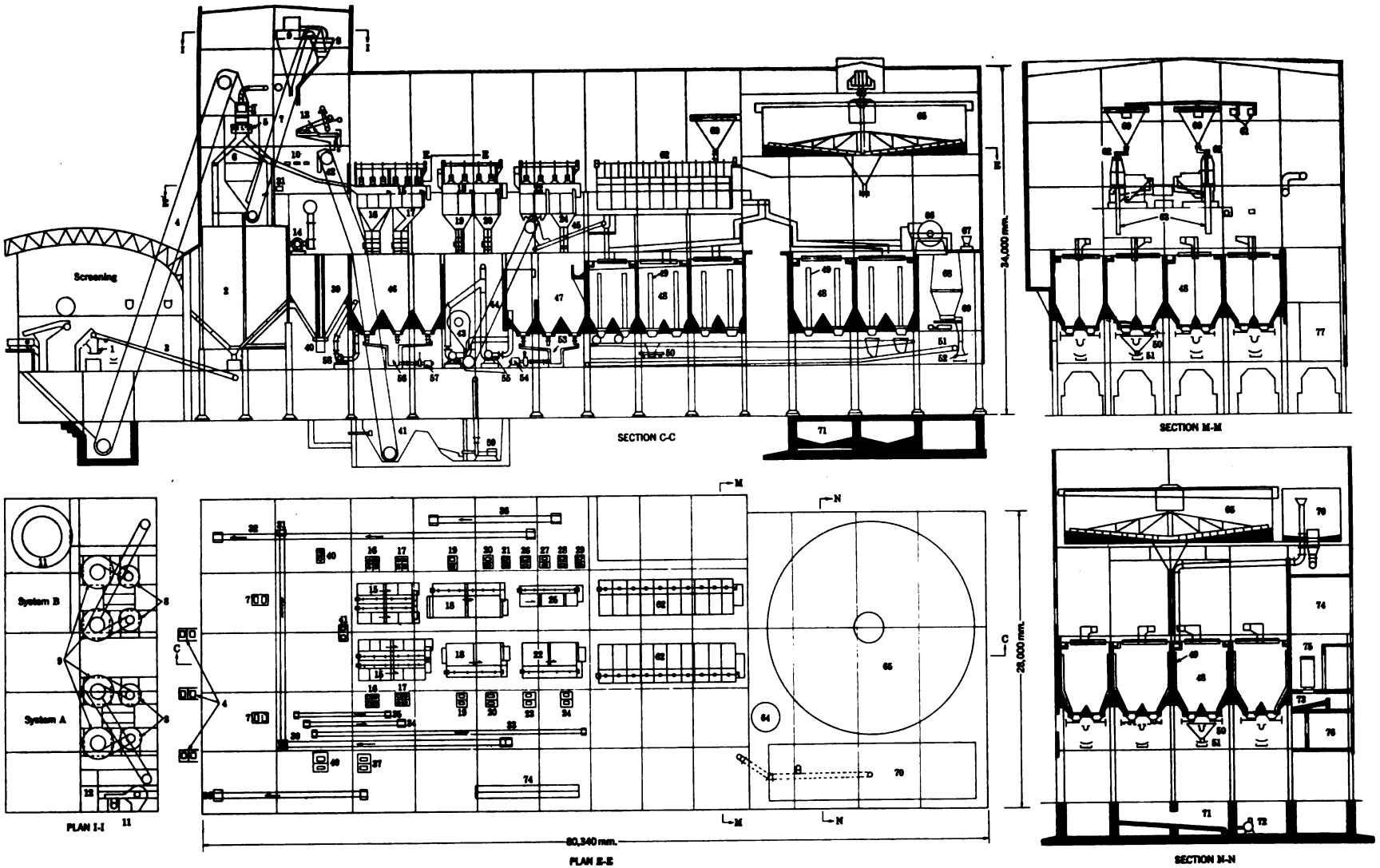


Figure 6. - Typical section of the Reinbaben washery.

Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Inasmuch as the two washing units for "Gaskohle" and "Fettkohle" are identical, a description of the "Gaskohle" unit will suffice for both.

The run-of-mine coal is screened at 80 mm. (3.15 inches). The 80 mm. lump goes to picking belts and the resultant 80 mm. only goes to the washery. In the washery, the 80 x 0 mm. coal is screened into three sizes: 80 x 25 mm. (3.15 x 1 inch), 25 x 10 mm. (1 x 0.39 inch), and 10 x 0 mm. (0.39 x 0 inch) with 43, 38, and 119 tons per hour, respectively.

The two coarse sizes go to separate Baum jig boxes. All boxes are provided with automatic slate gate controls (SKB Austragregler), and all automatic devices at the time of inspection were working. Some of them are provided with additional air-regulating devices (Luftzusatzregulierung), which are connected to the air-inlet valves to regulate the amount of air admitted to the jigs for pulsation.

An important feature of the SKB washery design is the method of handling the fine coal, 10 x 0 mm. (0.39 x 0 inch). This coal is elevated to the top of the washery building, where it is first dedusted pneumatically with the Humboldt rapid sichter dedusting equipment. This system, devised by Klöckner-Humboldt-Deutz A. G., Cologne, is described and illustrated in the equipment section of this report.

After dedusting, the fine coal is further deslimed over four SKB desliming screens of half-millimeter wedge wire. Each screen has a surface of three square meters (32.3 sq. ft.) and a capacity of about 8 tons per square meter (0.82 ton per sq. ft.) per hour. The thickness of the coal layer on the screens is about 4 centimeters (1.57 inches). These screens are sprayed intensively with water to wash the fines through the screen.

Dr. Kuhn, chief engineer of SKB, estimated that such screens, running at 550 strokes a minute and operating on 10 x 0 mm. coal not previously dedusted, would have a capacity of 5 to 6 tons per square meter per hour over bronze wire-cloth screens with openings 1.0 x 0.8 mm. The deslimed coal would have no particles under 0.35 mm. The feed may be as fine as 6 x 0 mm. (0.236 x 0 inch), but normally they would treat a feed of 10 x 0 mm. (0.39 x 0 inch). The spray water amounts to 1 ton of water to 0.8 to 1.0 ton of coal.

At Rheinbaben, the dedusted and deslimed fine coal contains no more than 1 percent under 0.7 mm.; whereas, without preliminary dedusting, the feed to the jigs after prescreening would carry approximately 10 percent of such fines. Owing to the fact that the fine coal is so well deslimed, the wash water for the jigs has a solid content of no more than 18 grams per liter.

Dewatering Fine Coal

The washed fine coal is transported from the jigs directly to large draining towers (Schwemm-Sümpfe). No dewatering screens are used ahead of these towers. Each tower has a capacity of 100 tons. After filling the towers, the valves of the four vertical dewatering pipes within the tower are opened so that the water can be drained off. Small pipes for air admission, not shown on drawing 2243, are provided on top of the drain pipes.

Generated on 2024-09-19 17:22 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Because of the dedusting and desliming of the fine coal before washing, draining in the drainage towers is very rapid and effective. After 4 hours' draining, the moisture content of the fine coal if 12 percent, and after 8 hours it declines to 8 percent, including 1 to 2 percent of vein moisture. Standard specifications have been set up for these draining-bin accessory pipes. (See fig. 5.)

The wash water from the desliming screens (under 0.7 mm.) goes to a cone of 4 meters (13.1 feet) diameter, and the settled material is treated by froth flotation. The flotation plant consists of 20 cells and has a capacity of 80 tons per hour, including both "Gaskohle" and "Fettkohle." SKB mechanical frothers similar to the mineral separation cells are used.

The water and tailings from the flotation plant, 150 cubic meters per hour (660 gallons per minute) go to settling ponds.

The overflow water from the fine coal-draining towers goes to a cone, where the coarser material settles (Körnersumpf). The overflow of this cone goes to a 22 meter (72 feet) diameter thickener (Rundeindicker), which reduces the solids content from 20 grams per liter to 18 grams per liter. The settled material goes to the flotation plant.

The froth from the flotation plant is treated in an SKB froth breaker before filtering. This treatment is said to increase the rate of filtering by 100 percent. There are two rotary drum filters, each having a surface area of 16 square meters (172 square feet). An interesting feature of the filters is that the feed is admitted to one side and not in the trough under the filter. The moisture content of the filter cake is approximately 18 percent. (See fig. 7.)

Storage of Filter Cake

The filter cake is conveyed to small, conical loading hoppers with rotating plate dischargers at the bottom, which are said to be very effective for handling stubborn fines that are difficult to move in bins and chutes.

15. Augusta Victoria Plant

This preparation plant is at shaft No. 111 near Recklinghausen. It is a conventional piston jig washery of 200 tons per hour capacity, of typical Westphalia-Dinnendahl-Gröppel (Wedag) design, erected in 1936.

The flow sheet of this plant is shown in figure 8 and general arrangement drawings in figure 9. The plant is housed in substantial steel and concrete buildings of a size indicating, together with a general appraisal of the total equipment, a capital investment very much larger than would generally be considered in American practice to be appropriate to a through-put of 200 tons of coal per hour.

In the presizing plant, which is housed in a separate building along with the lump coal picking tables, the run-of-mine coal is screened at 80 mm. (3.1 inches) and the lump coal goes to picking belts.

Generated on 2024-09-19 17:29 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

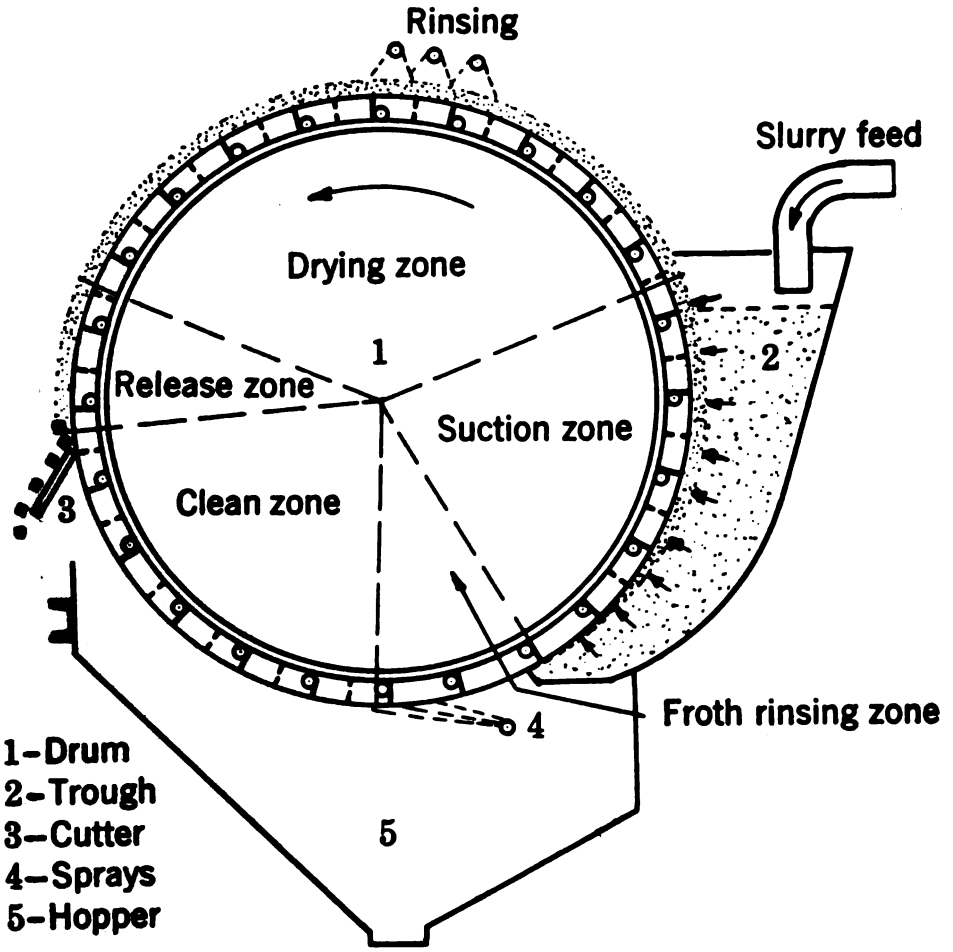


Figure 7. - SKB vacuum filter arrangement.

Generated on 2024-09-19 17:23 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Generated on 2024-09-19 17:22 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

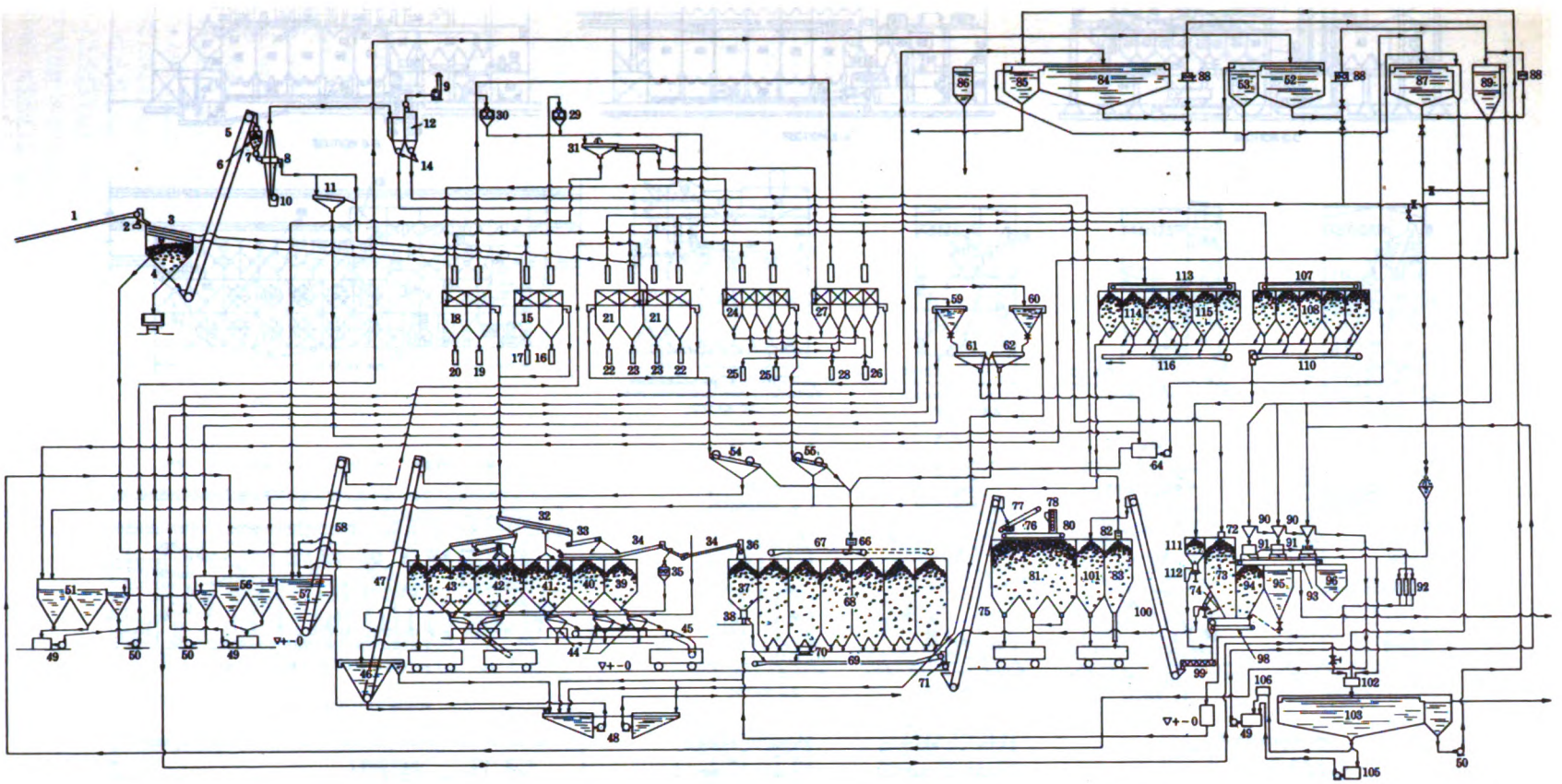


Figure 8. - Flow sheet of the washery at Augusta Victoria colliery.

Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Generated on 2024-09-19 17:26 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

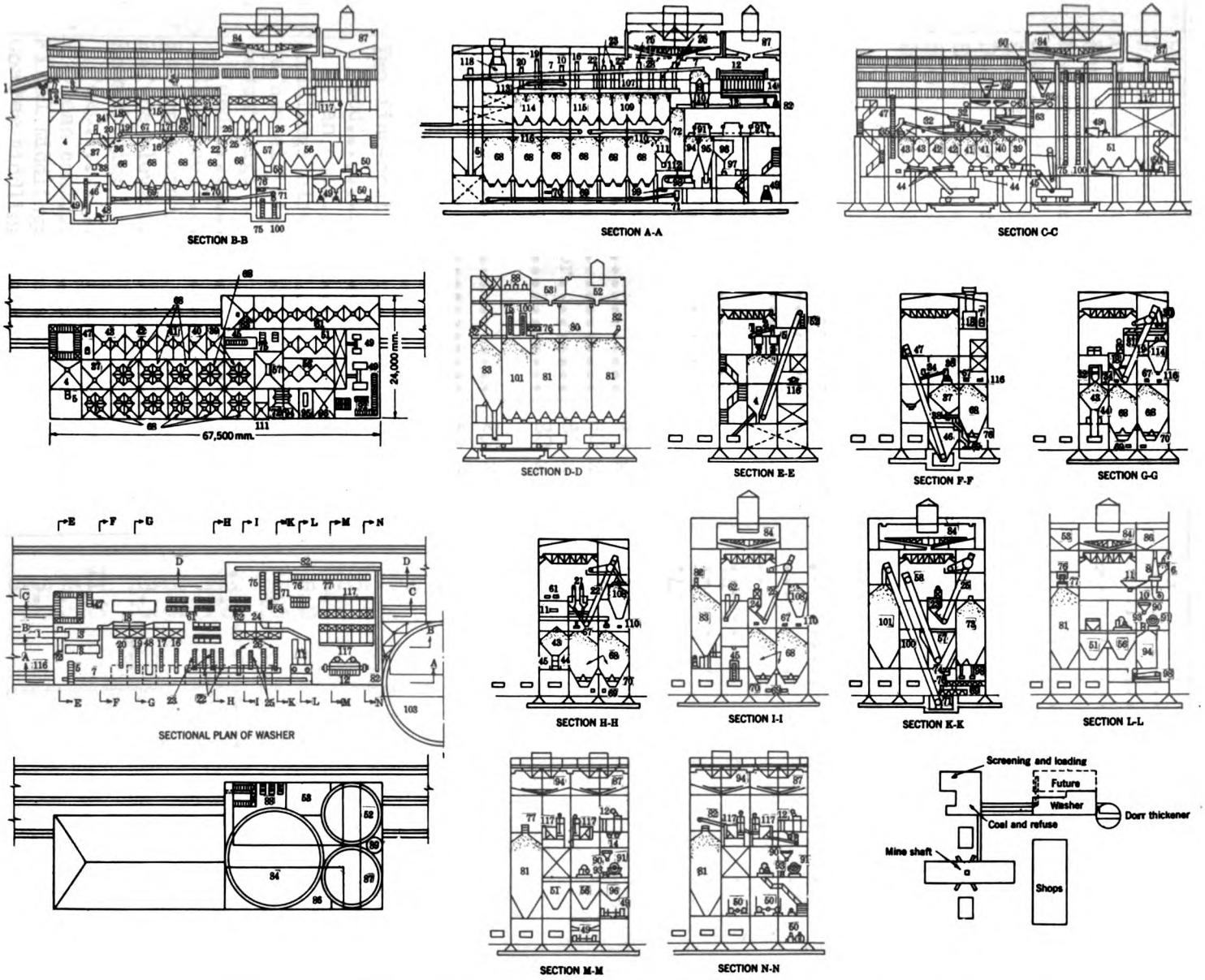


Figure 9. - General arrangement of washery at Augusta Victoria colliery..

Digitized by Google
Original from THE OHIO STATE UNIVERSITY

List of equipment in figures 8 and 9

Ref. No.	Item	Size of coal, mm.	Metric tons per hour	Capacity, metric tons	Elevation, meters
1	Raw-coal feed belt	0 x 80	200		
2	Raw-coal transfer belt	0 x 80			
3	Raw-coal preclassifier				
4	Raw fine-coal hopper	0 x 80	83	200	+23.0
5	Raw-coal bucket elevator	0 x 80	83		
6	Raw fine-coal bin	0 x 80		10	
7	Raw fine-coal belt conveyor	0 x 80			
8	Dedusting vibrator				
9	Exhaust fan				
10	Blower				
11	Deslurrying screen:				
	Feed	8 x 0.5	69		
	Over product	8 x 0.5	67		
	Through product	0.5 x 0	2		
12	Bag filters				
13	Dust conveyor				
14	Spiral conveyors:				
	Feed		14		
	Coarse dust		10		
	Fine dust		4		
15	Coarse-coal jig:				
	Feed	80 x 25	66		
	Clean coal	80 x 25	43		
16	Middlings elevator	80 x 25	8		
17	Refuse elevator	80 x 25	15		
18	Coarse-coal jig:				
	Feed	25 x 8	55		
	Clean coal	25 x 8	40		
19	Middlings elevator	25 x 8	6		
20	Refuse elevator	25 x 8	9		
21	Two fine-coal jigs:				
	Feed	8 x 0.5	35		
	Clean coal	8 x 0.5	41.5		
22	Middlings elevator	8 x 0.5	8.0		
23	Refuse elevator	8 x 0.5	12.5		
24	Rewash jig:				
	Feed	4 x 0.5	12.0		
	Clean coal	4 x 0.5	7.0		
25	Returned middlings elevator	4 x 0.5	3.5		
26	Refuse elevator	4 x 0.5	3.5		
27	Rewash jig:				
	Feed	8 x 4	11.0		
	Clean coal	8 x 4	6.0		
28	Final middlings elevator	8 x 4	3.0		
29	Coarse middling crusher	80 x 25	8		+26.0
30	Coarse middling crusher	25 x 8	6		+26.0
31	Deslurrying screens:				
	Crushed middlings feed	8 x 0	30		
	Product size	0.5 x 0	3		

Generated on 2024-09-19 17:22 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

List of equipment in figures 8 and 9 (Cont'd)

Ref. No.	Item	Size of coal, mm.	Metric tons per hour	Capacity, metric tons	Elevation, meters
	Product size	4 x 0.5	12		
	Product size	8 x 4	11		
	Product size	25 x 8	4		
32	Nut-coal classifiers:				
	Feed	80 x 8	83 plus 5		
	Sized nut product	80 x 8	76		
	Degradation		7		
33	No. 1 & 2 nut conveyor				
34	Two nut conveyors				
35	Double roll nut crusher				+14.0
36	Hammer mill nut crusher				+ 5.5
37	Crushed nut-coal bin				
38	Crushed nut-coal bin feeder				
39	No. 1 nut-coal bin		33	35	+14.0
40	No. 2 nut-coal bin			35	+14.0
41	No. 3 nut-coal bin			70	+14.0
42	No. 5 nut-coal bin			80	+14.0
43	No. 6 nut-coal bin			80	+14.0
44	Nut-coal loading screens				
45	Nut-coal loading conveyor				
46	Nut-coal degradation sump				
47	Bucket elevator		5		
48	Slurry sump pumps				— 4.2
49	Slurry sump pumps				0.0
50	Recirculating pumps				+ 5.5
51	Rewash water preclarifier				+12.4
52	Rewash slurry thickener			395	+37.0
53	Clarified rewash water tank			70	+37.0
54	Dewatering screen:				
	Feed	8 x 0	41.5		
	Over product	8 x 0.5	31.5		
	Through product	0.5 x 0	10.0		
55	Rewash coal dewatering screen:				
	Feed	8 x 0	13.0		
	On product	8 x 0.5	10.5		
	Through product		2.5		
56	Wash-water preclarifier				+11.9
57	Fine-coal degradation sump				
58	Fine-coal elevator		3.0		
59	Wash-water settling cone		9.0		+26.5
60	Rewash-water settling cone		1.5		+26.5
61	Four dewatering screens for main washer slurry				
62	Two dewatering screens for rewash slurry:				
	Over product		6.0		
	Through product		4.5		
63	Flight conveyor				

Generated on 2024-09-19 17:23 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

List of equipment in figures 8 and 9 (Cont'd)

Ref. No.	Item	Size of coal, mm.	Metric tons per hour	Capacity, metric tons	Elevation, meters
64	Slurry sump pump				
65	Belt conveyor				
66	Flight conveyor				
67	Belt conveyor				
68	Dewatering towers			2,200	+14.0
69	Crushed nut-coal conveyor				
70	Dewatered fine-coal feeder				
71	Spiral conveyor for crushed nut coal				
72	Coarse-dust conveyor				
73	Coarse-dust bin			10	+20.0
74	Coarse-dust feeder				+ 3.0
75	Bucket elevator				
76	Twin spiral conveyor				
77	Conveyor				
78	Centrifugal dryers dried product	3 x 0			
80	Dried-coal flight conveyor				
81	Coking-coal tower			1,200	+23.0
82	Raw fine-dust conveyor				
83	Raw fine-dust bin			300	
84	Dorr thickener for wash water slurry discharge		6.0	1,134	+37.0
85	Clarified-water tank			180	+36.8
86	Fresh-water tank				
87	Thickener for circuits carrying slurry water:			395	+37.0
	Slurry discharge		4.5		
	Slurry in overflow		2.0		
88	Diaphragm pumps				
89	Slurry tank				+34.8
90	Slurry cones				
91	Slurry filters				
92	Filtrate tanks				+ 9.6
93	Conveyor belt				
94	Slurry bin				
95	Waste water from sludge cone				
96	Sludge concentrate cone				
97	Pump				
98	Dried slurry conveyor				
99	Twin spiral conveyor				
100	Bucket elevator				
101	Steam coal bin			300	+23.0
102	Thickener for wash water overflow circuit				+ 5.5
103	Dorr thickener slurry discharge		5.0	2,168	— 5.4
105	Auxiliary pump				

Generated on 2024-09-19 17:22 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

List of equipment in figures 8 and 9 (Cont'd)

Ref. No.	Item	Size of coal, mm.	Metric tons per hour	Capacity, metric tons	Elevation, meters
106	Diaphragm pump.....				
107	Flight conveyor for middlings.....				
108-109	Middlings bins.....			60	
	Middlings.....		6.5		
110	Discharge conveyor from middlings bins.....				
111	Drained middlings bin.....				
112	Drained middlings bin feeder.....				
113	Refuse conveyor.....				
114	Coarse refuse bins.....			80	
	Coarse refuse.....		24.0		
115	Fine refuse bins.....			80	
	Fine refuse.....		16.0		
116	Discharge conveyor from refuse bins.....				
117	Future froth flotation plant (fig.8).....				
118	Room dust collecting apparatus.....				

Generated on 2024-09-19 17:27 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

The 80-mm. resultant coal is transported to the washery building by an inclined rubber belt conveyor of 1,200 mm. (47 inches) width on three-pulley carriers.

In the washery, the coal is screened on large Schieferstein screens, which are housed in an enclosure, so that the dust can be drawn away to dust collectors. These multideck screens divide the coal into the following sizes: 80 x 25 mm., 25 x 8 mm., and 8 x 0 mm. (3.1 x 1 inch, 1 x 0.31 inch, and 0.31 x 0 inch).

The 80 x 25 mm. size and the 25 x 8 mm. size are washed in separate piston-driven jig boxes 1.8 meters wide and 6.6 meters long (6 x 21.6 ft.). The 8- x 0-mm. size is washed in two piston jig boxes, each 2 meters wide and 5 meters long (6 ft. 6 in. x 16 ft. 6 in.).

At this plant all the jigs are equipped with automatic slate gate controls, but most of them were set in a fixed position, so that they could serve only to indicate the height of the slate bed and the opening of the gates. In those under automatic control this is effected by floats connected to oil-pressure cylinders to operate the slate gates.

The washed coal is screened into five different nut sizes and is delivered to bunkers by spiral chutes.

The fine coal is dedusted before delivery to the wash boxes. This is done in the Wedag Vibrator-Sichter, a kind of deduster in which the fine coal is fed over a vibrating screen through a high-velocity air current. After dedusting, the coal is deslimed on 0.5 mm. wedge-wire screens before going to the wash boxes.

The washed fine coal is dewatered on 0.5- or 0.3-mm. wedge-wire screens to a moisture content of about 30 percent. Then it goes to draining bunkers with gratings around the discharge gates, where it is reduced to a moisture content of approximately 10 percent.

Middlings of the coarse coal 80- x 25-mm. and 25- x 8-mm. go to crushers and then to vibrating screens (Schnellschwingsiebe) to remove the 0.5-mm. slurry. The crushed middlings sizing screens make 25- x 8-mm., 8- x 4-mm., and 4- x 0.5-mm. sizes. The 0.5- x 0-mm. slime goes to a sump. The 4- x 0.5-mm. and 8- x 4-mm. gradings are rewashed.

The clean coal from the rewash jigs is dewatered by screens and bins in the same way as the primary clean coal. Even the slate is drained in bins after part of the water has been removed in the slate elevators.

Slurry Treatment

The water and slurry under 0.5 mm. go to cones (Vorklassierungs-Spitzen). The settled material (about 0.5 x 0.1 mm.) from these cones is pumped to other cones (Spitzen), and the final settlings thence to 0.2 mm. screens. The product of these screens is added to the washed fine coal. The effluent (0.1 x 0 mm.) of the cones flows to a large thickener (on the roof of the washery) having a diameter of 20 meters (63.5 feet).

1299

Generated on 2024-09-19 17:21 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

The clarified overflow of the thickener is used again as wash water in the jigs. The settled slime goes to filters.

The water from the raw-coal slurry screens is kept separate and settled in smaller thickeners of 10 meters diameter (33 feet).

It is proposed in the future that the thickened slurry go to a froth flotation plant, but at present it is settled in cones (Spitzen), and the settled slurry from these cones is brought to filters.

The general washery effluent goes to a 25-meter (82 feet) thickener to obtain a final effluent of no more than 0.5 gram per liter of solids in the water.

16. Nordstern Colliery

Data on the product of this mine, which was used in the hydrogenation plant at Gelsenkirchen, were obtained from Dr. Jacob of Gelsenberg Benzin A. G. and from the builder, Westphalia-Dinnendahl-Gröppel A. G. The colliery company and the consuming company are associated as subsidiaries of Gelsenkirchener Bergwerksgesellschaft, which belongs to Vereinigte Stahlwerke. The coal is subject to intercompany movement only. For this reason, the specifications as to grade of coal were not too rigidly enforced.

The coal of selected seams of high-volatile content is prepared in a "Sophia Jacoba" washery (Sophia Jacoba is the German name of the Barvoys process licensed to Westphalia-Dinnendahl-Gröppel A. G.), which delivers a washed coal of 4.0 percent ash content by separation at approximately 1.45 specific gravity.

A typical petrographic report on the coal selected for hydrogenation is fusain, 2.2 percent; vitrain, 45 percent, clarain-durain, 52.8 percent. They have used coals of as much as 5.0 percent fusain and 1.5 percent of semi-fusain at Gelsenberg.

Fusain is regarded as an inert diluent constituent, which is not convertible but is not difficult to handle in the plant. The ash is not only inert but very troublesome as an obstruction to mechanical functioning of the converters.

Four percent ash was reported to be the most economical grade of hydrogenation fuel for use at Gelsenberg in view of the over-all economy of mine and conversion plant, although the operators of Gelsenberg Benzin would prefer a raw material of lower ash content.

The washed coal is shipped from Nordstern to Gelsenberg in the nut and slack size. At the works of Gelsenberg Benzin, it is dried to 1.0 percent moisture and pulverized in ball mills to pass a screen of 400 mesh to the square centimeter; approximately 40 percent will pass a screen of 10,000 mesh per square centimeter (0.06 mm.).

Generated on 2024-09-19 17:24 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

The statistical price of coal transferred from Nordstern to Gelsenberg Benzin A. G. was 24 marks per metric ton.

Coal hydrogenation plants using high-volatile bituminous coals from western Germany and Silesia were (1) Gelsenberg, considered above, (2) the Scholven plant near Buer, (3) The Poelitz plant near Stettin, and (4) Blechhamer in Upper Silesia.

Other plants using brown coal were operated at (1) Leuna, (2) Wesseling, and (3) Braunkohle Benzin A. G., and Brux. Ruhröl G.m.b.H. near Welheim-Bottrop operated on pitch.

Heavy-Medium Washery

The preparation plant at Nordstern is a typical heavy-medium plant of conventional Gröppel design. Drawings of this plant were not available, but general arrangement schemes were available for a similar plant presently being designed for Duhamel, a colliery at Hirschbach near Saarbrücken.

This plant will be designed to handle a total raw-coal load of 270 to 315 tons per hour, of which 65 percent over 10 mm. in size is to be handled in heavy-medium separators, Sophia Jacoba process, and 35 percent under 10 mm. in size will be handled in fine-coal jigs. The coarse coal will be pre-screened into two sizes - 80- x 30-mm. and 30- x 10-mm., to be washed in separate heavy-medium boxes.

The coarse coal, 80 x 30 mm., is dedusted on dry screens before going to the wash boxes.

The slack, 30 x 10 mm., is deslimed on wet screens before entering the wash boxes. Then, the specific gravity of separation is 1.40 and the make-up suspension must be about 1.55 in order to take care of the dilution of the medium by the wet coal entering the box.

If a separation at 1.6 specific gravity is required, the 30 x 10 mm. coal should be deslimed first by water and afterwards sprayed with a suspension of 1.6 specific gravity. The suspension coming from the screens and having a specific gravity of about 1.45 would then be thickened by a "star" centrifuge and returned to the system.

At present, the "star" centrifuge is in operation only at the Sophia Jacoba mine in Hückelhoven but will be introduced in other washeries of "Wedag" design.

The dirt from the heavy-medium boxes is rewashed in an upward current to take the middlings out separately.

The width of the baths, each for 75 to 100 tons per hour, is 2 meters (6½ feet).

Generated on 2024-09-19 17:26 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

A 30-meter (98 feet) diameter thickener will be used to thicken the barytes; but 20 meters diameter would do, also, according to the makers. Another 30-meter diameter thickener takes care of the washery and spray water from the washed nuts and the slack.

The slurry from the washed fine coal is to be thickened and put to vacuum filters.

The plant is being designed to use a closed circuit on the water, but flocculation is not provided.

17. Zeche Carl Alexander

This operation at Baesweiler, near Alsdorf, was especially directed for the production of Reinstkohle of 0.5 to 0.7 percent ash adapted to the very special purpose of preparing carbon electrodes for the aluminum industry. It is a privately owned mining property, but the entire product was delivered to the Rheinisch-Westfälisches Kohlen-Syndikat for sale.

The coal if a bituminous coking variety of 20 to 21 percent volatile matter. Mining and preparation operations were concentrated on the working of certain selected seams that respond best to supercleaning.

The washery is divided into a normal part for making coking coal and a special part for making electrode coal. The numbers in the description below refer to the flow sheet (fig. 10).

The raw coal is screened at 80 mm. and the resultant coal passing through the screen is sized on screen (2) into 80- x 0.75-mm. and 0.75- x 0-mm. grades. The 80- x 0.75-mm. size again is screened into 80- x 10-mm. nuts and 10- x 0.75-mm. fine coal, which are washed on two Baum jig wash boxes (3). The 0.75- x 0-mm. material from the pre-screen (2) goes to a preflotation plant (9), which consists of flotation boxes similar to the mineral separation type but are manufactured by Schüchtermann und Kremer-Baum A. G.

The froth from these machines can go either to drum filters (11) or to the main flotation plant for further refining by selective flotation.

The froth from the preflotation plant contains about 4 percent ash. When electrode coal is being made, this product is four times refloated in the main flotation plant. This means that the froth from the primary flotation cells of 4 percent ash is fed to the first box and refloated. Then the froth from the first box is transported by an elevator to the feed part of the second box and is again refloated, and this is continued through four stages. The ash content is reduced in these four stages successively to 2.5 percent, 1.8 percent, and finally 1.1 percent.

Each flotation unit consists of 4 cells; each system (block) consists of 6 units; and there are 6 systems, or a total of 36 four-cell units.

The maximum capacity reached with the 36 units was 6,000 tons of cleanest coal monthly. Work was continuous during 24 hours, including Sundays, so that

Generated on 2024-09-19 17:22 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Generated on 2024-09-19 17:23 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

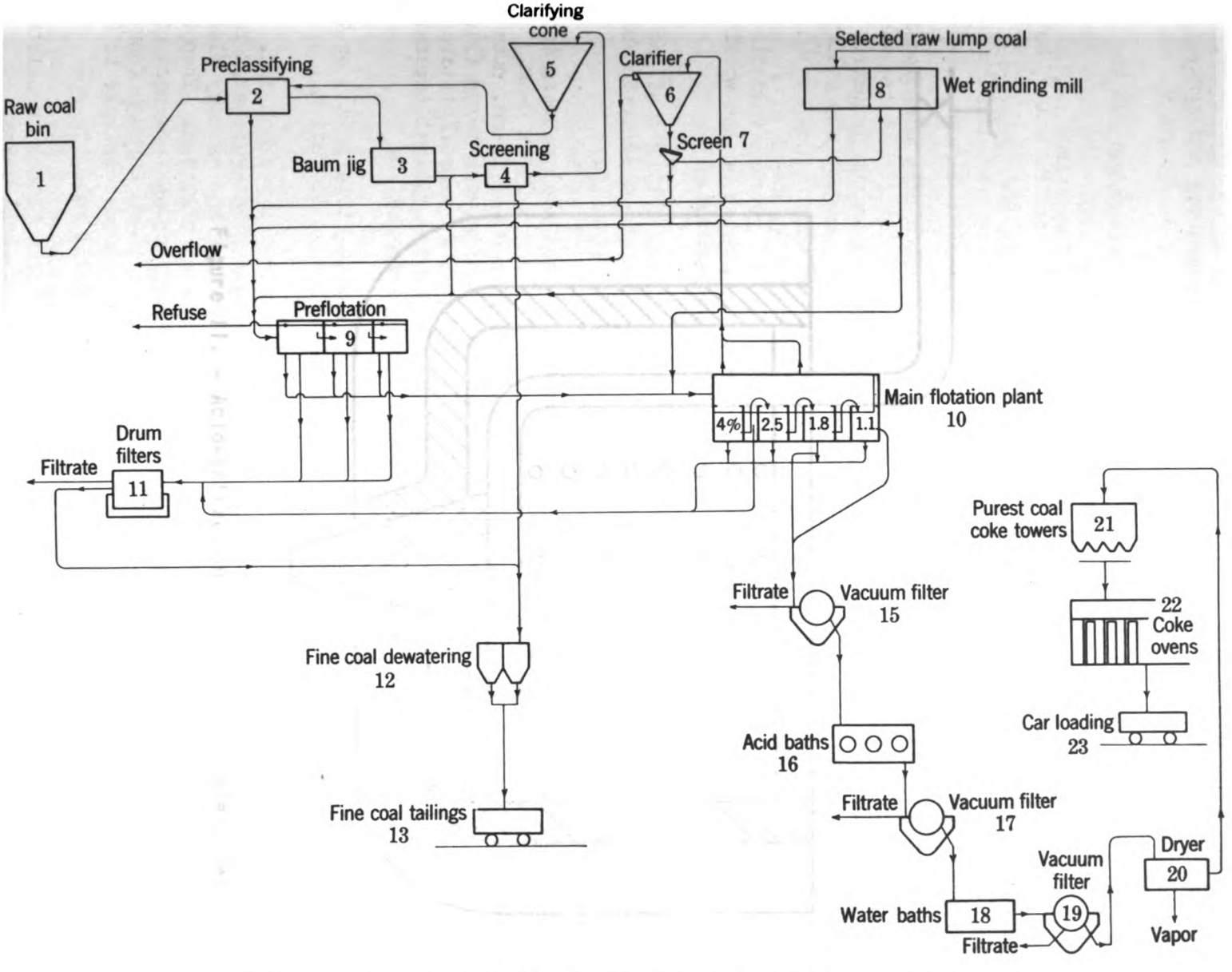


Figure 10. - Flow sheet of washery at Zeche Carl Alexander.

Digitized by Google
Original from THE OHIO STATE UNIVERSITY

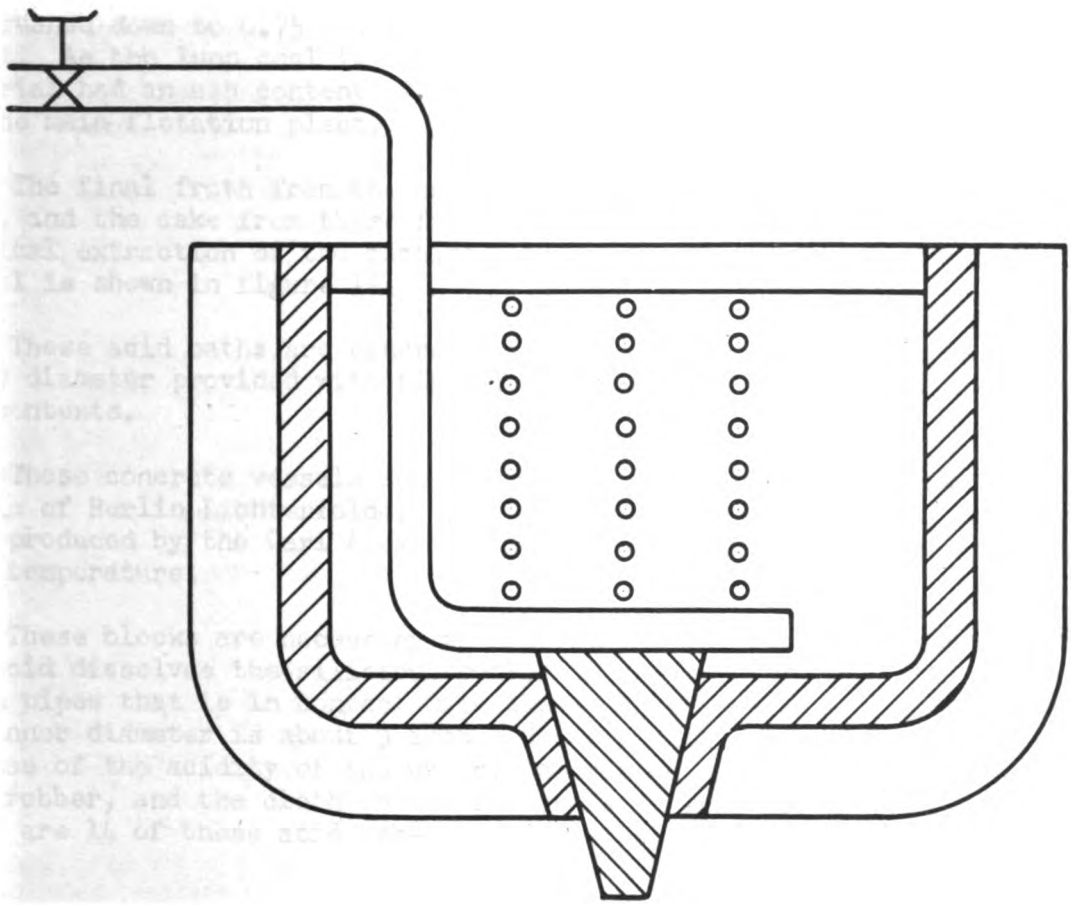


Figure 11. - Acid-extraction cells at Carl Alexander.

Generated on 2024-09-19 17:23 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

the capacity of the plant was $\frac{6,000}{24 \times 30} = 8.4$ tons per hour. However, 6,000 tons a month was acknowledged to be an exception. The normal rate of production was about 5,000 tons per month.

The flotation reagent used was a beechwood tar oil (Buchenholzteeröl), and this was added to the entering feed. Sometimes it was necessary to add a little additional reagent to the following stages.

Besides the slimes from the run-of-mine coal (1 and 2), lump coal could be crushed down to 0.75 mm. to furnish additional feed to the Reinstkohle plant. As the lump coal is selected and, therefore, low in ash, the crushed material had an ash content of about 4 percent and could be admitted directly to the main flotation plant.

The final froth from the main flotation plant went to vacuum filters (15), and the cake from these filters went to the acid baths (16) for the chemical extraction of the remaining mineral matter. A cross section of the vessel is shown in figure 11.

These acid baths are concrete vessels of about 3 to 4 meters (10 to 13 feet) diameter provided with pipes for circulating superheated steam through the contents.

These concrete vessels are lined with carbon blocks made by Siemens-Plania of Berlin Lichterfelde. These carbon blocks are made of the purest coke produced by the Carl Alexander plant, mixed with pitch and fused at a high temperature.

These blocks are necessary to protect the concrete from the reagent acid. The acid dissolves the silicious matter of the coal slurry. The part of the steam pipes that is in contact with the acid is also made of pressed carbon. The inner diameter is about 3 inches and the wall thickness is 2½ inches. Because of the acidity of the water, the rotary drum filters must be lined with rubber, and the cloth on the filter is of artificial resin (plastic). There are 14 of these acid ash-extractor units in the plant.

Ash Extraction

A mixture of water, hydrofluoric acid, and hydrochloric acid is made in the ratio of 100 parts of water to 1 of HFl and 2 of HCl, and the ratio of water to coal is 2 to 1. This indicates a total of 10 kilograms of hydrofluoric acid and 20 kilograms of hydrochloric acid in the mixture with 1 ton of dry coal.

The effluent water from the filters (17) is almost neutral, as virtually all the acid is consumed in dissolving out the coal-ash matter.

By this acid-extraction method, the ash content is reduced to 0.5 percent.

The cake from filter (17) is treated in the water baths (18) to remove the rest of the acid. From here it goes to the next filter (19).

Generated on 2024-09-19 17:22 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

The cake from filter (19) is dewatered in drier (20) and stored in (21). Further on, the purest coal (Reinstkohle) is coked in the normal way (22) and is then ready for shipment to the aluminum refinery, where it is pulverized and mixed with 30 percent of pitch to make the electrodes.

The main flotation process is continuous, and the coal stays about half an hour in the frothers. The acid baths operate on the batch principle, and the slurry stays in contact with the boiling acid for 1 hour.

As shown in table 8, the yield depends largely on the quality of the seams used.

TABLE 8. - Typical yields of various grades of pure coal

Ash, percent	Yield, percent		
	Seam 1	Seam 2	Seam 3
0.4.....	20	0	0
.4- .6.....	15	10	0
.6- .8.....	10	20	0
.8-1.2.....	30	15	0
Over 1.2.....	25	55	100
	100	100	100

Where seam 1 gives a theoretical yield of 75 percent of coal of an accumulative ash content of about 1.1 percent, seam 2 would give only 45 percent, and seam 3 is incapable of yielding any coal of that grade.

The flotation plant does not actually deliver the theoretical yield but perhaps 80 percent of the theoretical yield.

The advantage of the acid-extraction method is that the effective yield at 1.1 percent ash can actually be carried forward to the final de-ashed product of 0.5 percent ash content. If separation by float-and-sink methods to obtain the same end-ash content were attempted, the yield would be very much lower.

The tailings from the main flotation plant, still low in ash, were mixed with the fine coal from the jig washers and sold. The tailings from the pre-flotation plant (9), having an ash content of about 40 percent, were mixed with middlings from the jig washers (also about 40 percent ash) and fired on special Martin stokers.

The production of purest coal at Carl Alexander is stopped at present by bomb damage to the surface works; nor is there any need for purest coal for aluminum production in Germany at the moment. The production of normal coking coal of the plant at present is about 1,000 tons per day.

18. Zeche Koenigin Elisabeth

The Koenigin Elisabeth property belongs to Mannesmannrohren-Werke A. G. There are three shafts - (1) the Friedrich Joachim, (2) Hubert, and (3)

Generated on 2024-09-19 17:22 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

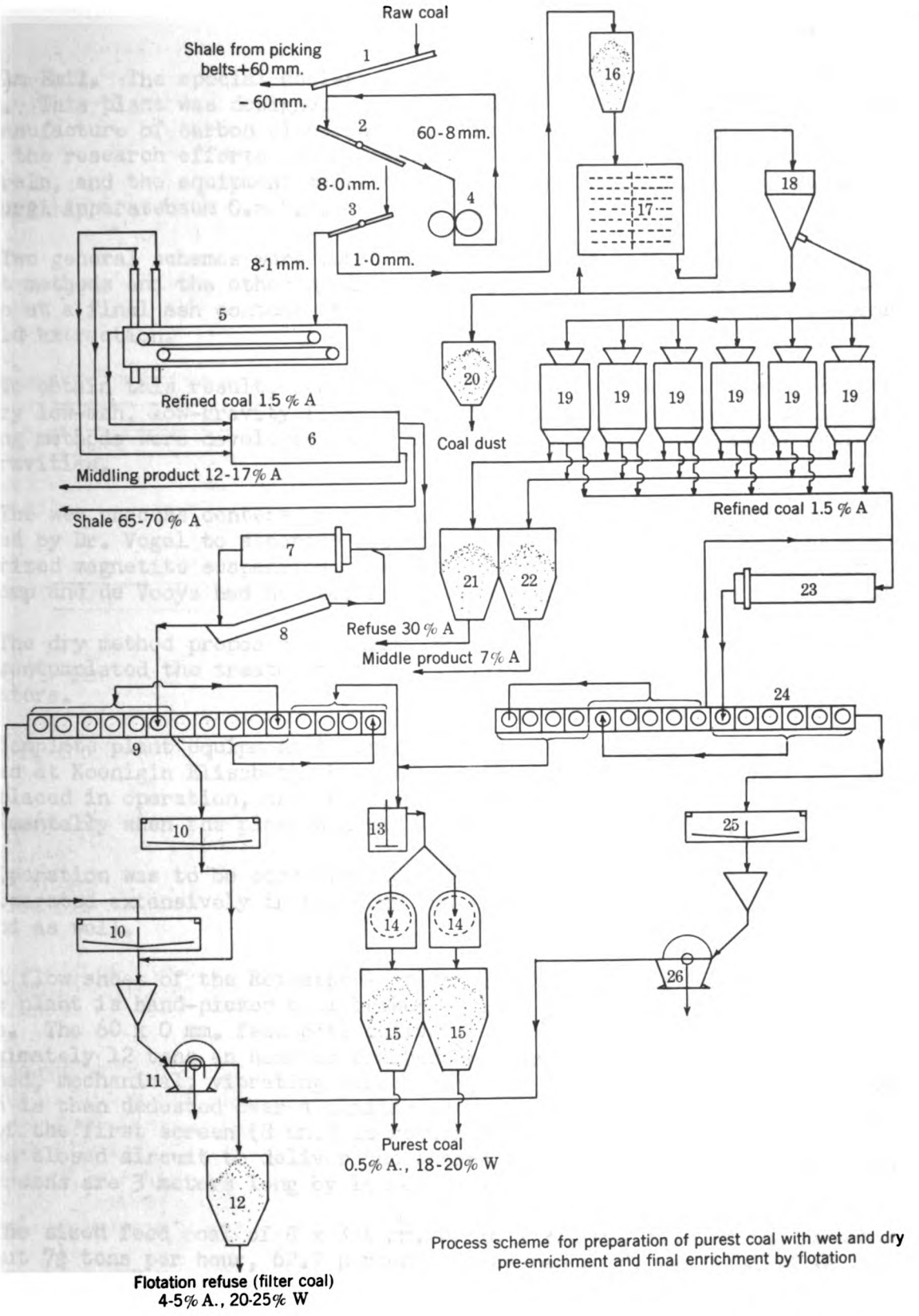


Figure 12. - Flow sheet of the Reinstkohle plant at Koenigin Elisabeth.

Generated on 2024-09-19 17:25 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Wilhelm Emil. The special coal-preparation plant is at the Wilhelm Emil shaft. This plant was designed especially to produce supercleaned coal for the manufacture of carbon electrodes for the aluminum industry. It combined the research efforts of the producing company, the specialists of Bergbauverein, and the equipment manufacturers, Krupp-Gruson A. G., of Magdeburg, and Lurgi Apparatebaum G.m.b.H., of Frankfurt.

Two general schemes were embodied in this plant - one treating the coal by wet methods and the other by dry methods. The objective of both was to arrive at a final ash content of 0.5 to 0.7 percent without having to resort to acid extraction.

To obtain this result, certain seams that contain the largest proportion of very low-ash, low-gravity float material were selected, and special separating methods were developed in an attempt to separate very small grains at low gravities.

The wet process centers around the Laminarström heavy suspension box devised by Dr. Vogel to separate grains as small as 1 mm. in a very finely pulverized magnetite suspension, whereas the older heavy-medium separators of Tromp and de Vooys had heretofore handled only material down to 5 mm. size.

The dry method proposed by Lurgi Apparatebau G.m.b.H. of Frankfurt am Main contemplated the treatment of 1½- x 0.1-mm. grains by electrostatic separators.

Complete plant equipment to operate by these two methods had been installed at Koenigin Elisabeth, but the electrostatic separators had not yet been placed in operation, and the second Laminarström plant had worked only experimentally when the plant was partly demolished by bombing.

Operation was to be concentrated on coal from the widely known Finefrau seam operated extensively in the Ruhr and in the South Limburg field of Holland as well.

A flow sheet of the Reinstkohle plant is shown in figure 12. The feed to the plant is hand-picked coal broken to pass a 60-mm. (2.36-inch) bar screen. The 60 x 0 mm. feed coal delivered to the plant at the rate of approximately 12 tons an hour is crushed and sized over 8 mm. cloth on an inclined, mechanical, vibrating screen (1); the 8 x 0 mm. undersize from this screen is then dedusted over a similar screen with 3/4 mm. cloth. The oversize of the first screen (8 mm.) is returned to the crusher, which operates thus in closed circuit to deliver the entire feed finally at 8 x 0 mm. size. The screens are 3 meters long by 1½ meters wide (9.8 x 4.9 feet).

The sized feed coal of 8 x 3/4 mm. or 10 x 3/4 mm. size, which amounted to about 7½ tons per hour, 62.7 percent of the raw feed, was handled in one Vogel Laminarström washer.

The Laminarström washer is a rectangular box 18 meters (59 feet) long by approximately 1 meter (3.28 feet) wide and 1 meter deep placed in a horizontal

Generated on 2024-09-19 17:25 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

position. A slow-moving scraper line traverses the upper part of the box. This scraper line consists of two matched strands of roller chain which operate entirely above the liquid in the box but carry pivoted rectangular scraper flights that dip into the liquid on the lower run, traveling from the feed end to the discharge end of the box. In this part of the run the scrapers are held in a vertical position by outriders on each side of the attachments that secure the scrapers to the sidebars of the chain. The return run of this scraper line is above the box and clear of the contents.

In the bottom of the box is an entirely separate drag chain that conveys the sink material to the discharge end. Both scraper lines travel at such a velocity as to traverse the 18 meters length of the box in 3½ minutes.

The separating medium, a suspension of magnetite in water, flows through this box at a very slow rate. The theory of control of the separations is that the suspension solids, of known size consist and controlled degree of dispersion at the moment of entering the box at the feed end, will settle at a predeterminable rate during the interval in which the stream traverses the length of the box; hence, the effective specific gravity at the point of final separation of the load particles will be precisely determined, taking into account the settlement of the medium. This is presumed to be a more precise control condition than can be obtained by means of the so-called "stable" suspensions that are not perfectly stable.

The function of the top scraper line, as conceived by the inventor, is to hold the top layer of the flowing stream in place and induce a more uniform slow rate of travel, so that all parts of the top layer, divided into inter-scraper sections, may be constrained to move at the prescribed rate throughout the length of the box.

The suspension is delivered to the feed end of the separator box by a series of return pipes purporting to start predetermined proportions of the medium in several superimposed layers of the stream in the box so as to safeguard further the uniform flow and the lamination of the moving contents of the stream.

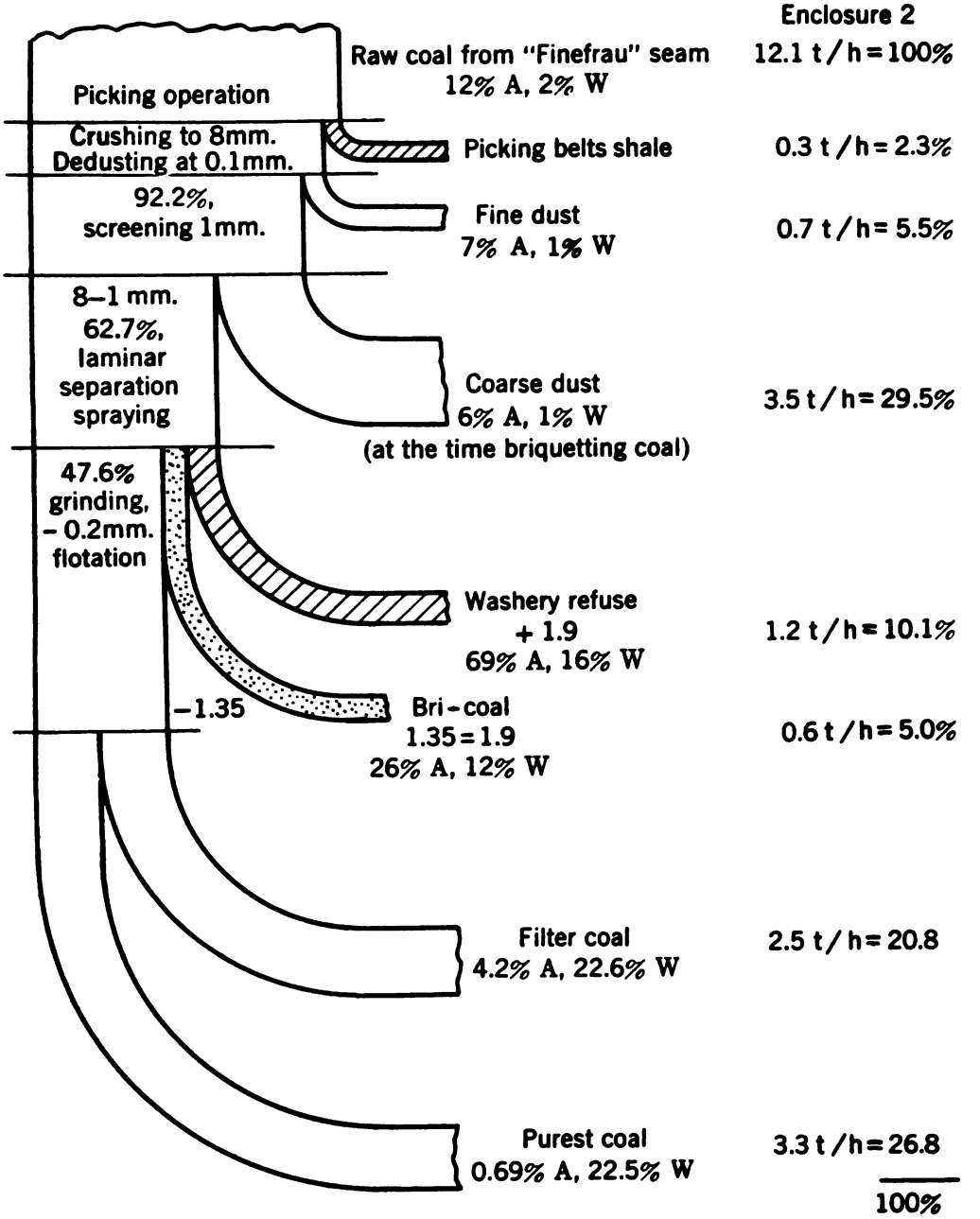
The specific gravity of the feed suspension was controlled by a mechanical sampling and weighing device that diverted samples from the return line to a sample receptacle carried on a scale beam.

The operation was reported to have been based upon a feed suspension gravity of 1.30, which at the delivery end of the apparatus resulted in a three-product separation. Owing to interim differential settlement of the suspension, the top-layer product, discharged as pure coal, carried 1.3 percent ash; the bottom layer, discharged by a refuse drag, carried 86 percent ash; and the intermediate layer, discharged as a middling product, carried 10 percent to 14 percent ash. The yield of pure coal was approximately 5.6 tons per hour.

The refuse and middling products dropped into separate submerged Redler-type elevator boots, and the solid material was elevated and discharged to the rinsing screens by a two-compartment inclined Redler elevator with two chains in each compartment.

Generated on 2024-09-19 17:22 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Enclosure 2



Quantity floating picture for production of purest coal in the purest coal plant Koenigin - Elisabeth according to the output obtained in February 1944 (1st stage)

Figure 13. - Quantitative flow diagram of Reinstkohle plant at Koenigin Elisabeth.

Generated on 2024-09-19 17:22 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

All three products - pure coal, middlings, and refuse - are rinsed on one horizontal Schieferstein resonance screen divided longitudinally into three compartments.

This screen is 8 meters (26 feet) long and is clothed with 0.25-mm. wedge wire in short sections 1 meter (3.28 feet) in length divided into steps, with a drop of about 5 cm. (2 inches) between steps.

The layer of coal on the screen has a depth of 5 to 8 cm. (2 to 3 inches). The screen is driven at 900 r.p.m. by an eccentric and connecting-rod drive with 12-horsepower motor. The steel screen supports have an inclination of about 45 degrees, giving the screen a substantial rise on the forward stroke.

The suspension is recovered by a magnetic separator. The suspension containing coal and shale slurry is fed to a rubber belt running over a magnetic pulley. The magnetite adheres to the belt, and the water flushes away the nonmagnetic coal and shale particles. Further on, the magnetite on the belt is demagnetized by alternating current and washed off into the storage tank.

The middlings of the Laminarström box, with about 15 percent ash, were added to the dry-screened raw fines for briquetting purposes, and the refuse was sent to the pit heap. The pure coal, with 1.3 percent ash content, was milled in a ball mill (7) in closed circuit with a rake classifier (8) to return the oversize (over approximately 0.75 mm.) to the mill. The small particles under 0.75 mm. were delivered to the flotation plant (9). The mineral separation-type frother reduced the ash content from 1.3 percent to 0.7 percent; the final froth product was treated in a froth destroyer (13) and then dewatered by the filters (14).

Figure 13 is a quantitative flow diagram of typical operation.

These data, furnished by Dr. Herman Meyer of Bergbauverein, are representative performance data obtained during experimental operation of the first Laminarström unit.

Electrostatic Separators

In the dry plant, the dedusted coal from screen (3), 1 mm., was to be fed to the electrostatic separators (19) after being dried in a Büttner turbine dryer (17). The electrostatic separator plant consists of 6 machines, each provided with 12 separator units in 2 parallel banks of 6 units, one under the other; in this respect very much like the Johnson separator. The separator elements are 20 cm. (7.8 inches) in diameter and 2.5 m. (8.2 feet) in length.

The DC tension amounts to 25,000 volts. This installation has not yet been in operation, and only laboratory experimental data were available; but the designers expect that the dry process will produce about the same product as the wet plant.

Generated on 2024-09-19 17:24 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

19. Preparation of Hydrogenation Fuel

Apparently no special techniques have been developed for preparation of coal to be used in the hydrogenation process of producing liquid fuel.

Coal was supplied from a number of collieries in the Ruhr district, including pits of Hibernia A. G., the State-controlled mines, and the Nordstern pit near Gelsenkirchen.

In some of these plants the coal was washed by the conventional jigging system, in which only the coarse coal was used for hydrogenation and the fines carrying most of the fusain were diverted to the coke ovens.

The most commonly reported ash specification for hydrogenation coal is 4.0 percent. Although it is considered very desirable, from an operating point of view, to have lower ash coal, 4.0 percent was apparently the most desirable specification for economic use of the fuel. Generally, the Ruhr coals will yield a coal of that grade by the conventional methods, but any substantial reduction below that level of ash content entails an uneconomical sacrifice in yield.

In heavy-suspension plants, a clean coal of 4.0 percent ash is commonly obtained by separation at around 1.45 specific gravity.

In some cases it is reported that certain seams were worked separately to obtain a preferred coal fro hydrogenation - that is, to obtain coal of favorable petrographic characteristics with high hydrogen content and low oxygen. It is important to have a high concentration of the brighter coal constituents with a low proportion of fusain and opaque matter.

DEVICES AND TECHNIQUES

20. Schieferstein Screen

The Schieferstein resonance screen is very widely used in the Ruhr area for difficult sizing jobs and for heavy tonnages. It is considered to be more effective than normal shaking and vibrating screens.

A drawing showing the general arrangement of this screen is shown in figure 14. Shop drawings of one balanced double-deck design will be available in the files of the Bureau of Mines in Washington, D. C.

The unique feature of this screen is the resonance element incorporated into the screen supports and drive arms. A picture drawing of one type of resonance supporting element is shown in figure 15. These are in effect live-rubber shock absorbers mounted between the screen frame brackets and the fixed structure, as shown in figure 14, in such a way that on each stroke one resonance element is compressed and the other extended, and on the reverse stroke these stresses are reversed. A somewhat similar element in the drive arms relieves the reactions that would otherwise be transmitted through the drive arms to the drive shaft. When the screen motion is synchronized with the

Generated on 2024-09-19 17:21 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

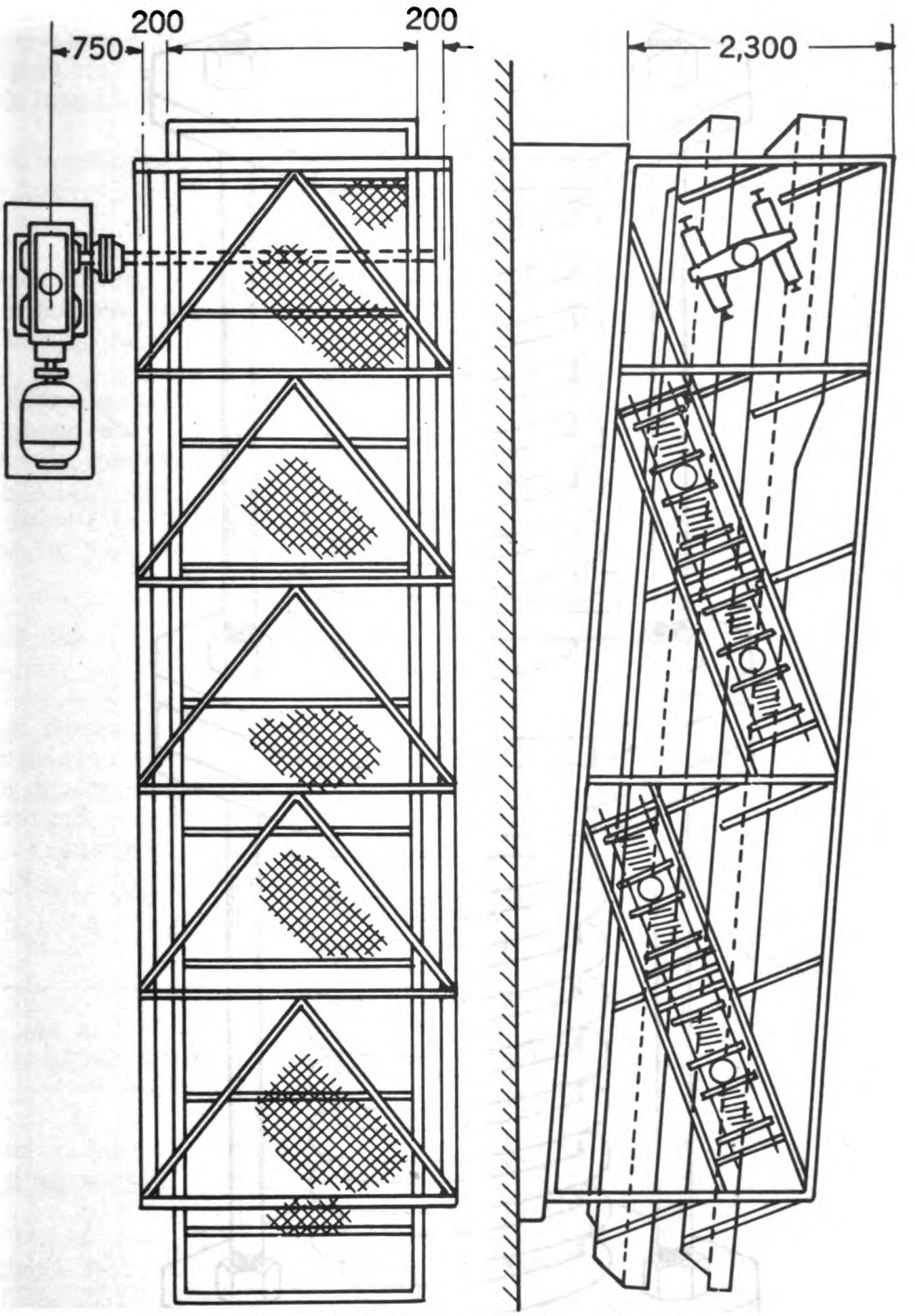


Figure 14. - Schieferstein resonance screen.

Generated on 2024-09-19 17:23 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from
THE OHIO STATE UNIVERSITY

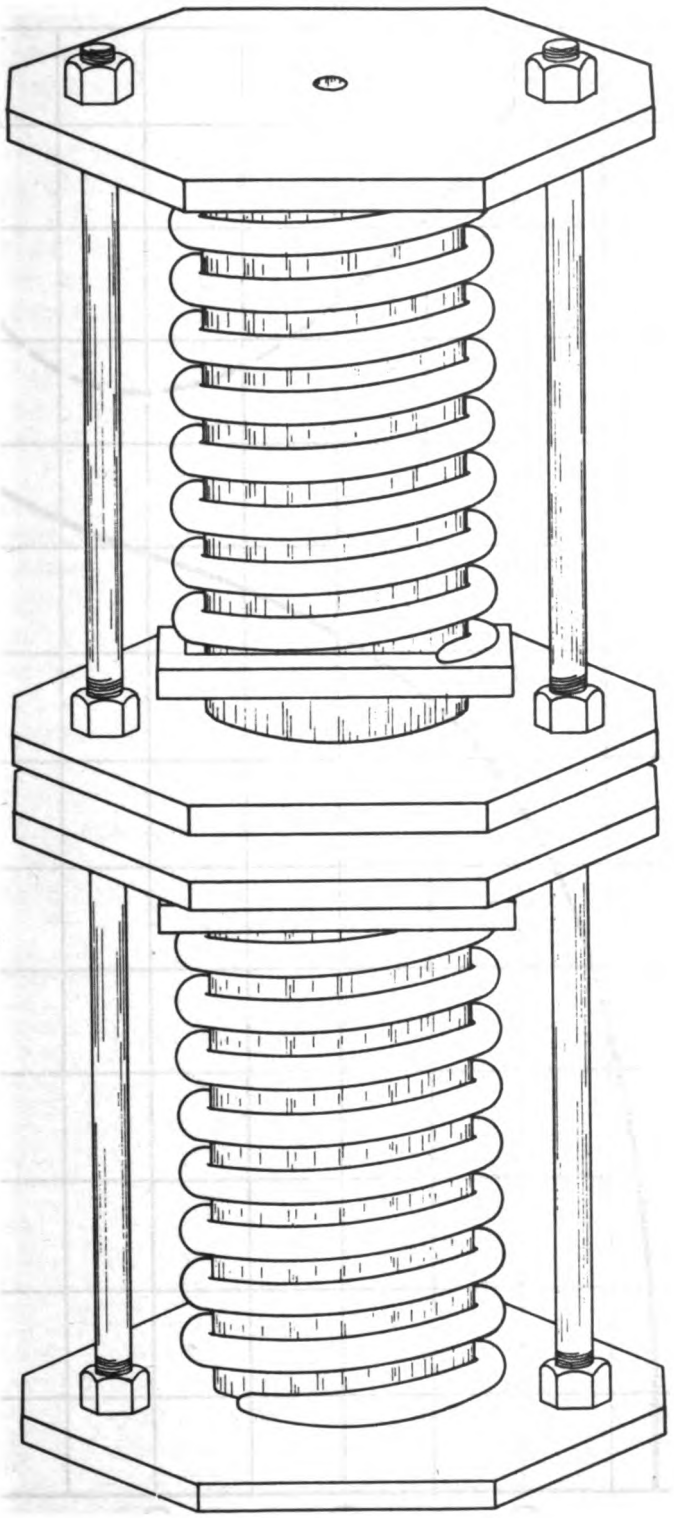


Figure 15. - Resonance element of the Schieferstein screen.

Generated on 2024-09-19 17:25 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Generated on 2024-09-19 17:27 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

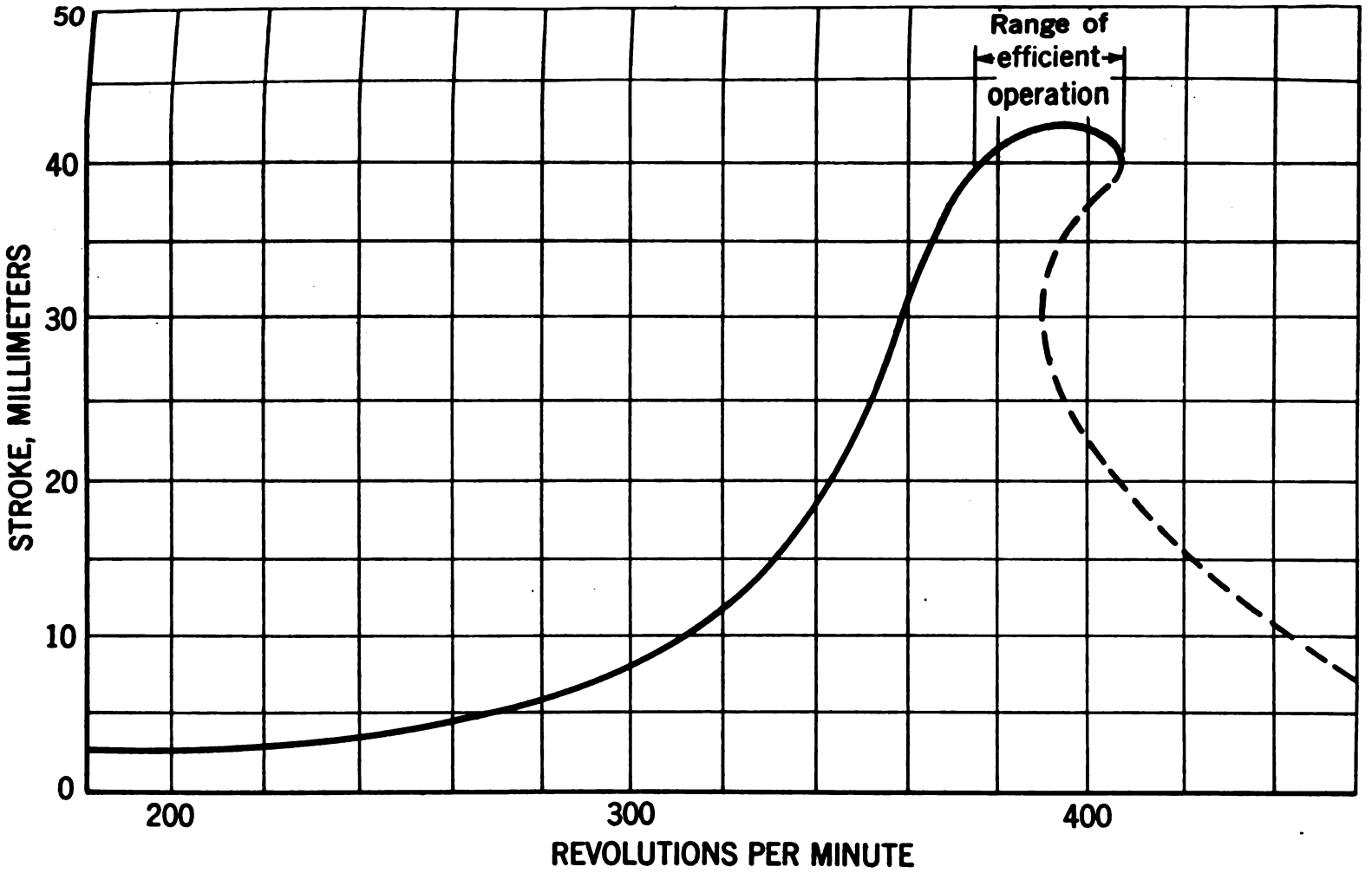


Figure 16. - Typical stroke-characteristic curve of a resonance screen.

Digitized by Google
Original from THE OHIO STATE UNIVERSITY

harmonic period of the resonance elements, the machine is operating in resonance. Under these conditions, the energy requirements are very low, and reactions transmitted to the supporting structure are at the minimum. A large part of the energy put into the resonance elements is returned to the screen on the reverse stroke.

Each type and model is tested in the works to ascertain the proper relationship of screen motion and resonance elements to arrive at the preferred operating speed and stroke. The screen is in resonance when driven at the speed that gives the maximum length of stroke ascertained by the shop test. A typical test curve showing the relation of stroke length to speed in strokes per minute is shown in figure 16. In this instance, the range of efficient operation would be about 375 to 405 r.p.m.

The resonance principle of operation has been applied to heavy mine-run shakers and to light high-speed dewatering and fine-screening sieves. Control of the patents was vested in a syndicate, which licensed three manufacturers: Carlshütte Maschinen und Stahlbau-Gesellshaft, Waldenburg; Krupp-Gruson A. G., Magdeburg; and Klöckner-Humboldt-Deutz A. G., Cologne. Shop drawings are being obtained from the Humboldt firm.

The other two plants were not visited, but an interview was obtained with Dr. W. Kluge, formerly associated with Carlshütte, who is at the Branch Office temporarily located in Steele near Essen. An assembly drawing of one Carlshütte model of the Schieferstein screen will be in the file.

Performance data on a typical screen installation are given in table 9.

TABLE 9. - Summary of tests of a single-deck resonance screen

Part I: - Operating characteristics

Type of screen:	Single-deck resonance.
Width of screen:	1,400 mm. (55 inches).
Length of screen:	5,000 mm. (197 inches).
Screen cover:	0.25- x 1.0-mm. mesh.
Effective screen area:	4.2 x 1.3 = 5.5 square meters (59 sq. ft.).
Stroke:	Length, 10 mm., frequency, 650 r.p.m. (0.39 inch).
Transport, speed:	v = 0.18 meters per second (0.6 in. per second).
Load:	29.5 tons per hour = 5.3 tons per square meter per hour of fine coal (0.5 tons per sq. ft.).
	16.8 tons per hour - 3.0 tons per square meter per hour of slurry (0.3 tons per sq. ft.).
Rinsing water:	3 sprays 7.5 cubic meters per hour each, totaling 22.5 cubic meters per hour (99 gal. per minute).
Motor capacity:	5 hp., 500 volt, 5.7 amp., 1,435 r.p.m.
Idle running:	2.3 hp., 500 volt, 2.3 amp., 1,465 r.p.m.
Starting current:	35 amp.; starting time; 1 second.
Loaded:	2.6 hp., 500 volt; 2.6 amp.; 1,466 r.p.m.
Energy consumption:	0.09 hp.-hour per ton of fine coal.
	0.15 hp.-hour per ton for slurry.

Generated on 2024-09-19 17:26 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Generated on 2024-09-19 17:23 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

TABLE 9. - Summary of tests of a single-deck resonance screen (Cont'd)

PART II. - Screen analysis (sizes in millimeters)

(a) Fine coal, 6 x 0 mm.

Date of test	Sample	No. of sprays	T/H	Over 6		6 x 3		3 x 1		1 x 0.5		0.5 x 0.25		Under 0.25		Average ash, percent	Solids, grams, percent	Water, percent
				Wt. %	Ash %	Wt. %	Ash %	Wt. %	Ash %	Wt. %	Ash %	Wt. %	Ash %	Wt. %	Ash %			
7.6.43	A	1	a25	2.1	8.1	26.0	4.5	40.7	4.9	15.3	9.8	9.3	23.3	6.6	37.6	10.7		69.0
	B	1		1.2	9.5	23.6	6.3	46.2	6.1	18.8	10.5	8.6	20.5	1.6	33.2	7.9		23.2
	C			-	-	-	-	-	-	-	-	18.2	52.2	81.8	48.6	47.6	60	-
7.6.43	A			1.2	13.3	24.4	7.5	41.4	6.8	17.3	12.9	8.8	26.6	6.9	37.9	11.3		65.1
	B	2	a25	1.4	8.9	23.9	7.2	46.4	7.6	18.1	14.6	8.5	25.3	1.7	39.2	11.3		20.7
	C			-	-	-	-	-	-	-	-	10.4	21.9	89.6	37.1	35.6	48	-
x	A			1.6	11.7	25.3	7.1	42.6	7.4	16.3	13.6	7.7	27.0	6.5	39.2	12.7		69.0
8.6.43	B	3	29.5	1.2	14.7	24.2	7.9	47.9	8.0	17.5	16.5	8.0	27.9	1.2	36.8	12.1		24.6*
	C			-	-	-	-	-	-	-	-	18.1	58.2	81.9	44.8	45.9	58	-

(b) Slurry 1 x 0 mm.

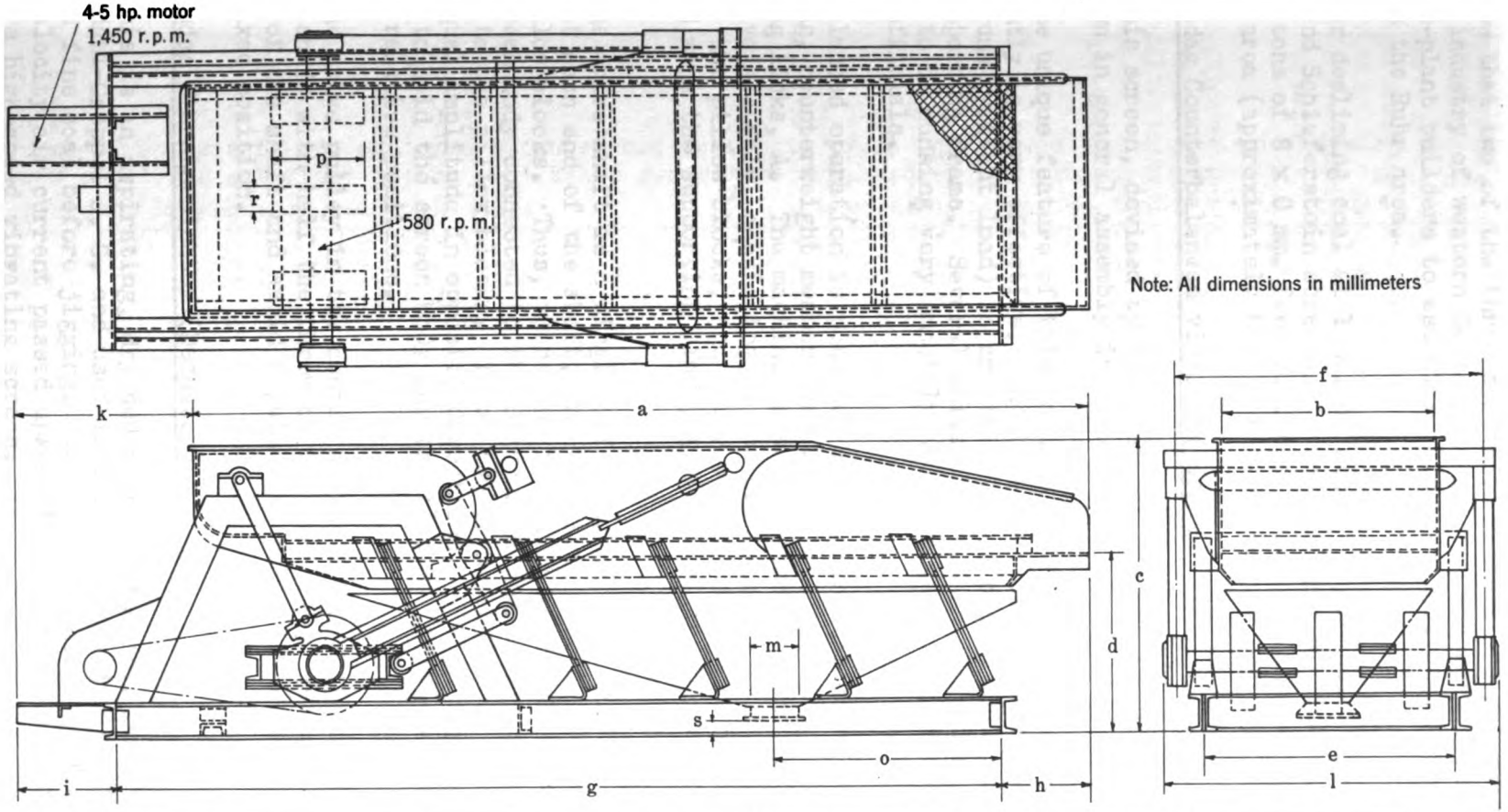
																	Per liter	
x	A			0.8	9.0	0.8	7.9	2.1	8.2	5.1	7.5	22.5	5.7	68.7	18.2	15.5	242	-
9.6.43	B	3	16.8	.7	13.4	1.5	13.6	4.5	6.6	17.6	3.9	42.3	4.7	33.4	11.7	7.2	-	35.4
	C			-	-	-	-	-	-	-	-	5.2	12.0	94.8	25.3	25.0	126	-

x - Items so marked were capacity tests. * - Moisture after 24 hours, 7.9 percent.

In each test, the top line, marked "A", gives the screen analysis of the feed coal; the second line, "B", gives the screen analysis of the oversize product; and the third line, "C", gives the screen analysis of the undersize product.

Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Generated on 2024-09-19 17:23 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google



Screen dimensions	a	b	c	d	e	f	g	h	i	k	l	m	o	p	r	s
800 wide x 4,200 lg.	4,200	800	1,250	760	970	1,190	4,260	200	360	550	1,334	200 diam.		400	120	50
1,000 wide x 4,200 lg.	4,200	1,000	1,250	774	1,170	1,430	4,064	390	350	604	1,574	250 diam.		450	120	70
1,200 wide x 4,200 lg.	4,200	1,200	1,320	768	1,370	1,630	4,248	390	467	829	1,810	300 diam.		450	120	70

Figure 17. - Wedag counterbalanced screen.

Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Now that two of the three syndicate members are not readily accessible to the industry of western Germany, a project has been sponsored by the preparation-plant builders to establish a new Schieferstein screen-fabricating shop in the Ruhr area.

For desliming coal at 1 mm. or finer, the Humboldt screen specialists recommend Schieferstein screens at about 480 r.p.m. with a rating of 4 to 5 metric tons of 8 x 0 mm. feed coal per hour per square meter of effective screen area (approximately half a ton per square foot).

21. Wedag Counterbalanced vibrating screen

This screen, devised by the staff of Westphalia-Dinnendahl-Gröppel A. G., is shown in general assembly in figure 17.

The unique feature of this machine is the counterbalancing scheme, which apparently is very effective. The test unit operated on the floor of the works runs (without load) so smoothly that a pencil will stand up on end on the supporting frame. Several units observed in operation in the field appeared to be running very smoothly and were generally praised by local operating officials.

Balanced operation is obtained by mounting the drive shaft in a heavy, floating, counterweight member hung from the supporting structure by two swinging links, A. The machine is so designed that the combined weight of the drive assembly, consisting of the crankshaft with its flywheels and drive pulley, the pillow blocks, and heavy cast-iron members on which they are mounted with the supporting links, A, is equal to the weight of the screen body.

The drive shaft is a single offset crank shaft with a drive arm on the crank at each end of the shaft, and the shaft itself is carried in the floating pillow blocks. Thus, there are in effect two driven elements in balance - the screen body connected to the drive arms and an equal counterweight connected to the pillow blocks. These two counterbalanced elements are driven with equal amplitude in opposite directions. The pantegraph arm, B, is a device to hold the screen body and the floating drive-support structure in proper relative positions.

The drive pulley in the center of the crank shaft is placed eccentrically on the shaft with half the throw of the cranks, so as to compensate for the motion of the shaft and avoid a pulsating pull on the motor, which is mounted in a fixed position.

22. Wedag Vibratorsichter (Deduster)

This is an aspirating, dry dedusting system developed by Westphalia-Dinnendahl-Gröppel A. G. and used in their preparation plants for pre-dedusting the fine coal before jigging. The dust is extracted from the coal by a high-velocity air current passed upward through the coal while it is traversing a high-speed vibrating screen.

Generated on 2024-09-19 17:26 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Dimension drawings of the principal elements in a typical plant are available in the file of the subcommittee.

The dust carried up by the air stream is first settled in a coarse-coal-catching chamber where the granular material is deposited. From there the air goes to a cyclone, in which the fine dust is settled. The dust catchers and the transferring column above the screen are operated under suction of about 15 to 20 mm. (6 to 8 in.) of water measured above the coal-feed screen. The fan is placed on the suction side of the collector.

In some installations, the air is handled in a closed circuit, in which case about 25 percent of excess outside air is taken in by leakage at and above the screen, and an equal amount must then be diverted to a fine-dust collector back of the cyclone, which discharges 25 percent of the circulating air load to the atmosphere. This may be a bag filter or a water-spray dust catcher. Where wet coal is to be anticipated, the excess air must be increased.

The typical dedusting unit has a net screen area of 125 by 150 cm. (49 x 60 inches) set at an inclination of 4 degrees from the horizontal. The screen is a round hole-punched plate with 1.5 mm. openings. The pattern is 460 holes per square decimeter to separate the coal at 0.3 mm. size and 570 holes per square decimeter to separate the coal at 0.5 mm. size (4,275 holes per square foot and 5,295 holes per square foot). Air circulation is at the rate of 400 cubic meters (14,125 cubic feet) per minute, and the pressure at the fan discharge is 60 to 100 mm. (2.4 to 3.9 inches) of water. The rated capacity of such a unit is 50 tons per hour of 10 x 0 mm. coal.

In some installations, heated air has been used to advantage for handling wet coal. It increases the effectiveness of dedusting and partly dries the dedusted coal, but performance data were not available.

23. Humboldt Rapidsichter (Deduster)

In the Humboldt deduster, the fine coal is introduced into the air stream in a thin curtain that falls through the rising air current and then discharges to the storage hopper via an inclined fixed screen. This screen serves mainly as a chute for the dedusted product, although the circulating air current passes upward through the screen before coming into contact with the feed coal.

The coal is fed evenly into the air stream by a rotating drum distributor, which delivers the coal in a very thin stream across the entire width of the drum. In handling the dust-laden air, the Humboldt deduster is similar to the Wedag system described above, except that a Raymond-type classifier is used to catch the granular coal ahead of the final air clarifiers, which usually are cyclone collectors. The classifiers and cyclones are sometimes lined with porcelain titles to eliminate replacement delays.

A typical drawing of a double-unit Humboldt deduster is shown in figure 18. The curves of figure 19 show typical performance data, and figure 20 gives some typical data on the effects of moisture and overloading upon the efficiency of operation.

Generated on 2024-09-19 17:27 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Generated on 2024-09-19 17:22 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

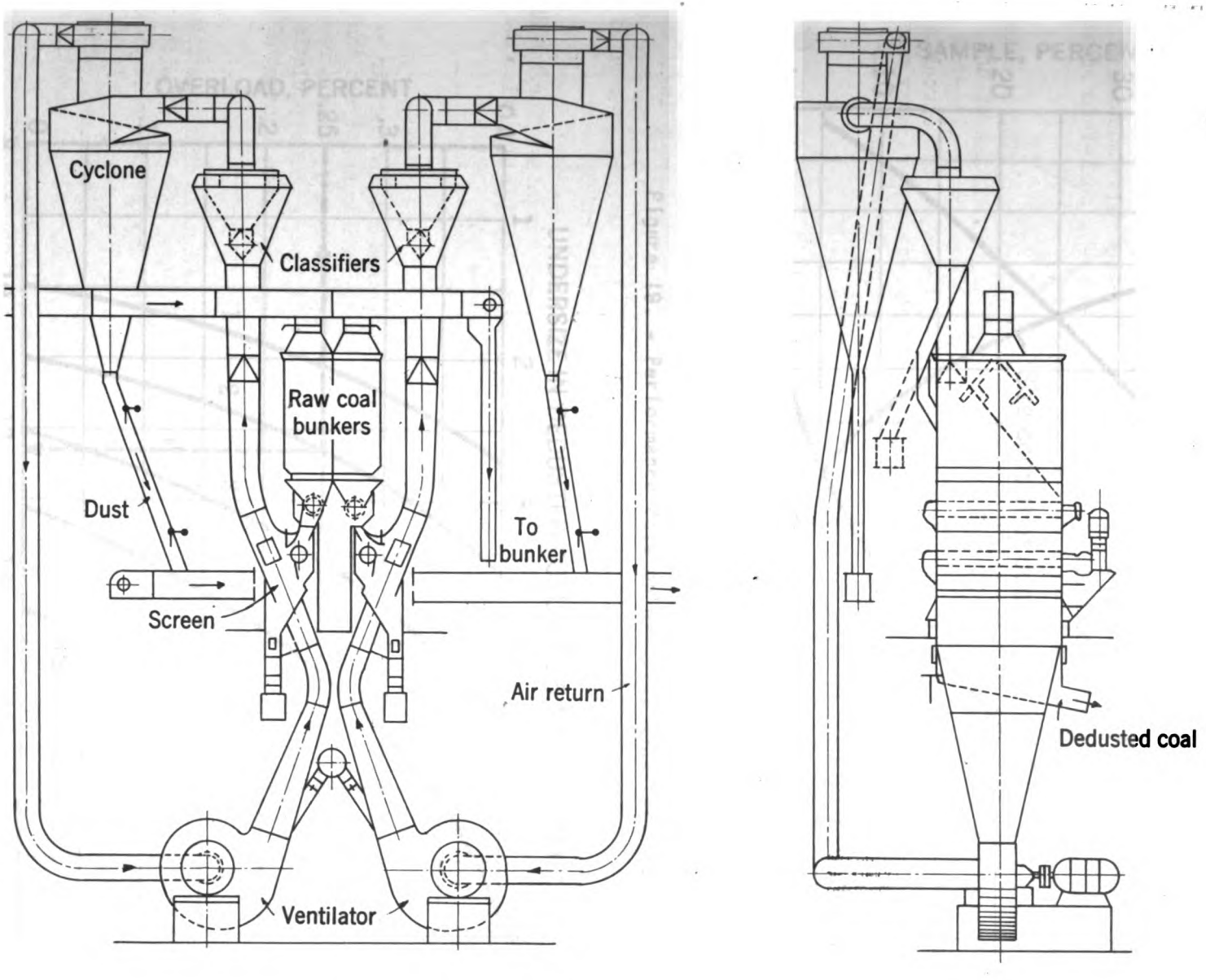


Figure 18. - Humboldt deduster (rapidsichter).

Digitized by Google
Original from THE OHIO STATE UNIVERSITY

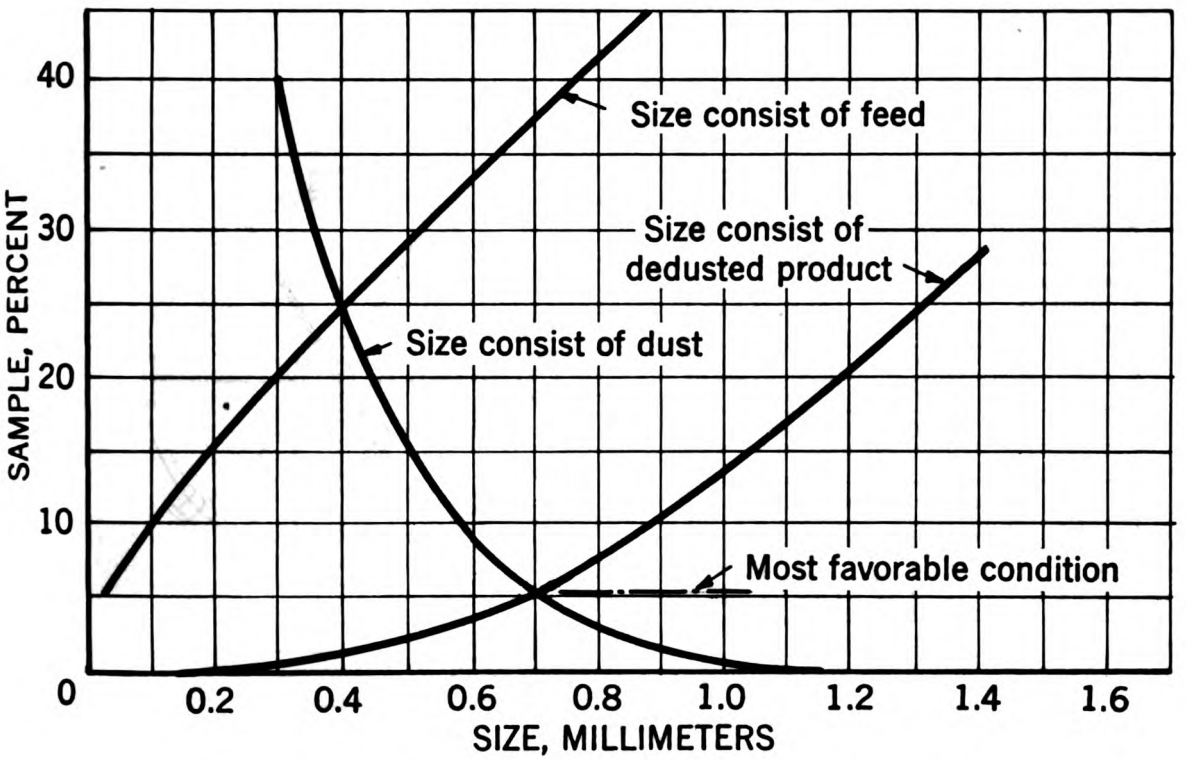


Figure 19. - Performance data on Hymboldt deduster.

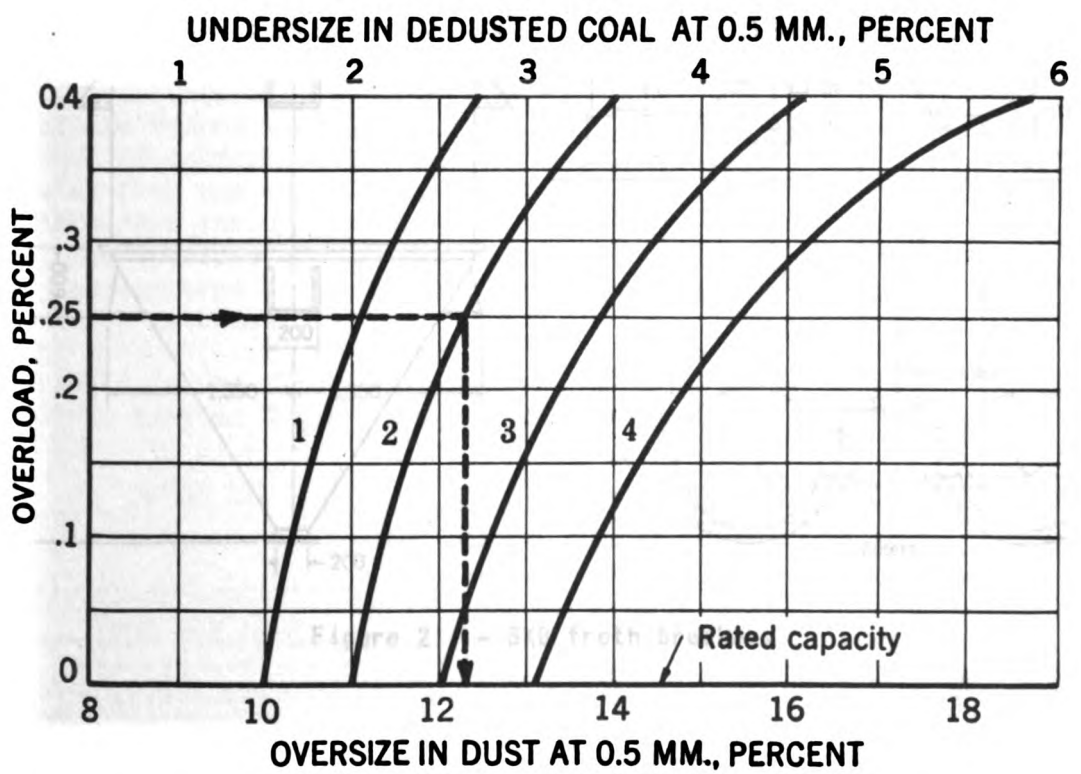
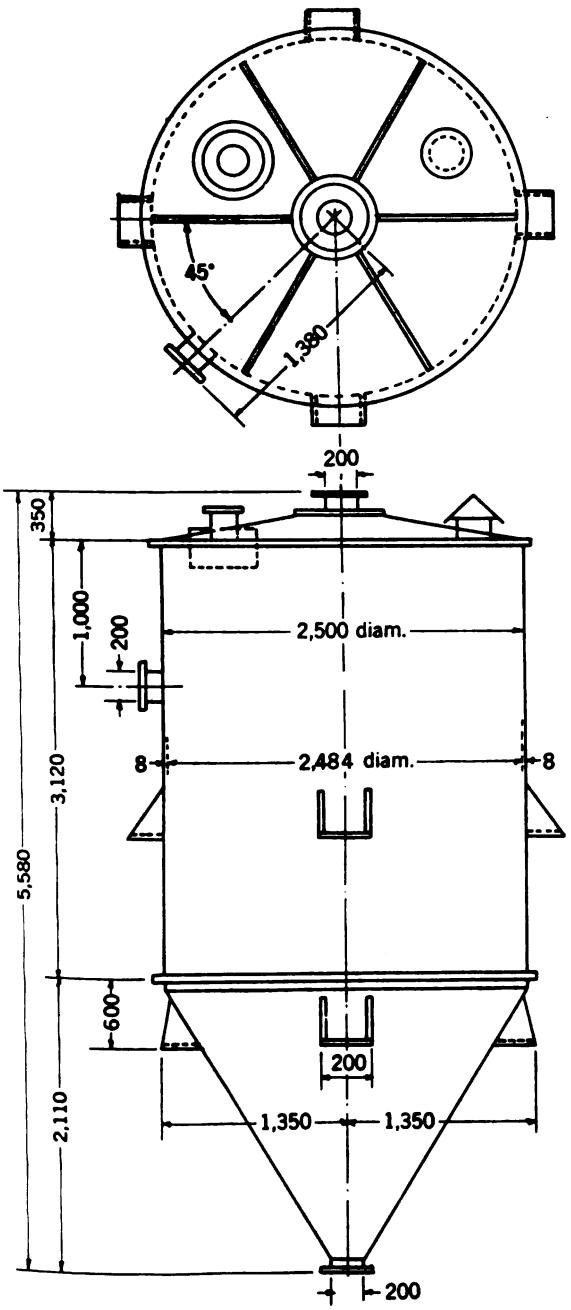


Figure 20. - Effect of moisture and load on deduster efficiency.

Generated on 2024-09-19 17:24 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY



Flotation concentrate, tons per hour	Water ring vacuum pump	
	Suction line, diam. in mm.	Amount of air exhausted in m.³ / min.
10	150	20
10-20	150	26
20-30	200	32

Height, meters					
H_1	2	4	6	8	9
H_2	5	6	7	8	8
H_3	7	6	5	4	3

Note: All dimensions in millimeters

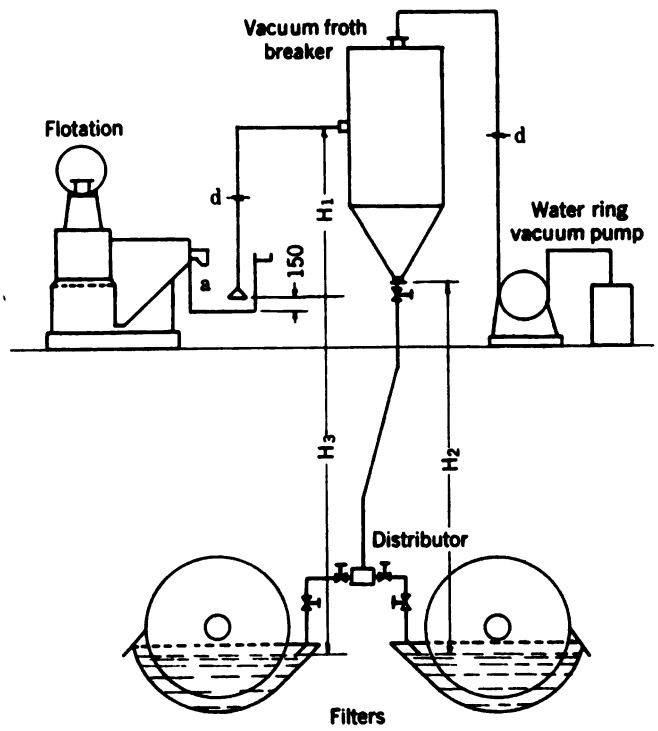


Figure 21. - SKB froth breaker.

Generated on 2024-09-19 17:26 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

At the large washery installation handling Westphalia coal, two of these Humboldt dedusting units handled 220 tons per hour of 10 x 0 mm. coal. Each unit consisted of one double deduster, two classifiers, one exhaust fan and motor, two collectors, one feed hopper with feeders, and two gear boxes with motors. Data on performance of this plant are given in table 10.

TABLE 10. - Performance (monthly average) of Humboldt deduster plant

(a)	Deduster set at 0.5 mm. size.	
	Dust in feed:	22.3 percent - 0.5 x 0 mm.
	Dust in dedusted coal:	2-5 percent - 0.5 x 0 mm.
	Oversize in dust:	13 percent plus 0.5 mm.
	Moisture content of feed:	2.1 percent.
(b)	Deduster set at 0.3 mm. size.	
	Dust in feed:	14 percent - 0.3 x 0 mm.
	Dust in dedusted coal:	2 percent 0.3 x 0 mm.
	Oversize in dust:	11 percent plus 0.3 mm.

4. SKB Froth Breaker

This is a device used to break down the froth from the flotation machines to facilitate handling and filtering the product. It is similar in effect to the Elmore Vacuum flotation machine in that the froth is broken down in vacuum.

A schematic drawing of the device is shown in figure 21. The froth from the flotation machines is discharged at rather high velocity into the vertical cylindrical vacuum tank, where it impinges on a central baffle plate. Details of the vacuum tank are shown on the left side of the illustration and the sequence of operations is shown in the upper right hand sketch. The air is exhausted from the tank by the water-ring vacuum pump. The defrothed coal slurry discharges through the conical tank hopper and then goes to the vacuum filters. The sponsors of this device report that it doubles the rate of filtering as compared to the method of filtering the frothy product direct from flotation machines.

The table in the illustration gives the principal design data and load rates. These data in English translation are given in table 11.

TABLE 11. - Data of the SKB vacuum froth destroyer

Flotation concentrate, tons per hour	Water-ring air pump: Suction pipe diameter, mm.	Water-ring air pump: Air aspirated, cubic meters per minute
10	150 (6 in.)	20 (706 cu. ft.)
10-20	150 (6 in.)	26 (918 cu. ft.)
20-30	200 (8 in.)	32 (1130 cu. ft.)

Generated on 2024-09-19 17:27 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

25. Discharge of Fine Coal From Bunkers

In the SKB plants, froth flotation filter cake is stored in narrow, conical hoppers fitted with rotating-plate discharge gates that are reported to be effective for handling extremely sticky, wet fines that ordinarily give much trouble in chutes and bins.

A rough sketch of this device is shown in figure 22. These hoppers are limited to 1 meter in diameter at the bottom discharge end, and the sides are almost vertical 80 to 85 degrees from the horizontal. The entire bottom of the hopper is open, and the contents are retained by a rotary plate gate a little below the bottom of the bin.

To discharge material, this plate is rotated at a peripheral speed of about 50 centimeters per second. The coal in contact with the disk is moved out toward the periphery by centrifugal force and is plowed off into the conveyor by a steel blade set at an angle on the rim of the disk.

In an alternate design for the most stubborn materials, shown in the right-hand view, a conical member is substituted for the plane discharge disk.

26. Washery-Control Devices

Automatic control devices for wash boxes are similar to those in common use in American and British fields. A float riding on the slate bed communicates its motion to an oil-operated piston that opens and closes the slate gates.

In a modification of this system found in a few of the SKB washeries, the motion of the float is communicated also to the air-inlet valves, so that an excessive accumulation of slate in the wash boxes brings about an increase in the air introduced into the pulsion chamber.

Fine-coal jigs, even those operating with feldspar, use these floats to regulate the discharge of refuse.

In the heavy-suspension washers, two methods of control were observed. (1) Measured samples of the medium were weighed at intervals to determine its specific gravity. In some plants mechanical devices were used to weight automatically a measured quantity of medium recovered from the rinse-water circuit and to recirculate the pulp back to the thickening device when the specific gravity is too low. (2) A specific gravity-indicating device consists of two static tubes inserted into the bath at a measured difference in level. Air is introduced through both tubes, so that it bubbles at a uniform rate into the bath, and a sensitive pressure gage in a U-tube connection linking the two measuring points registers the difference in pressure between the two levels in the bath.

Generated on 2024-09-19 17:26 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

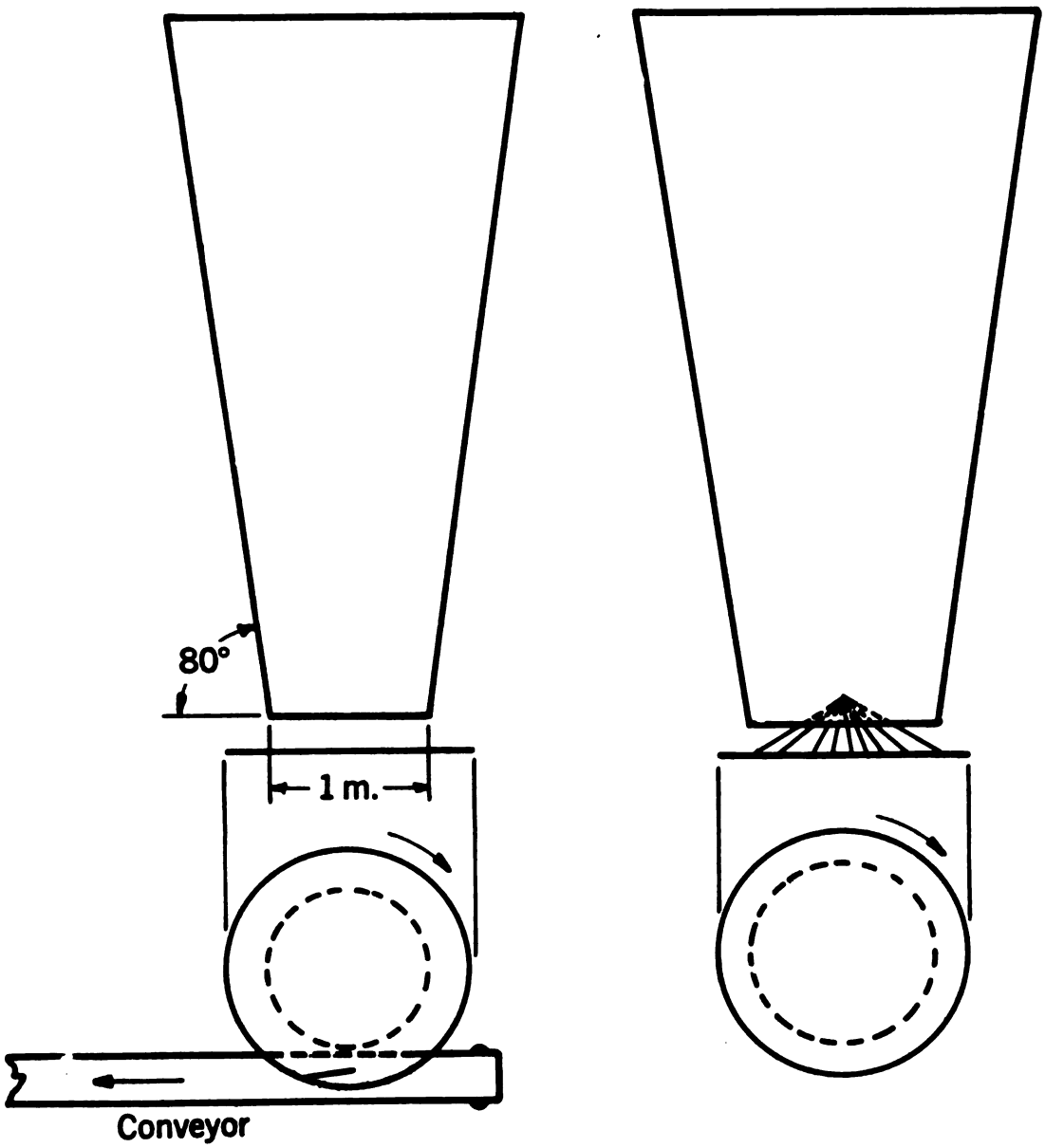
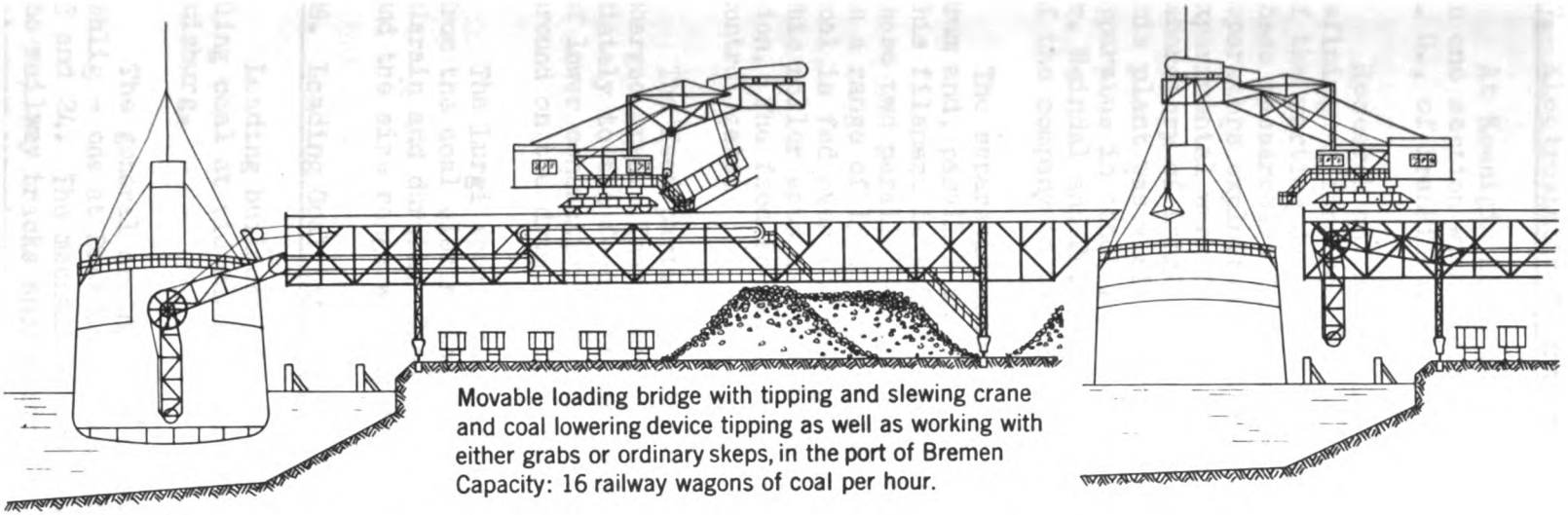


Figure 22. - SKB sludge bunker.

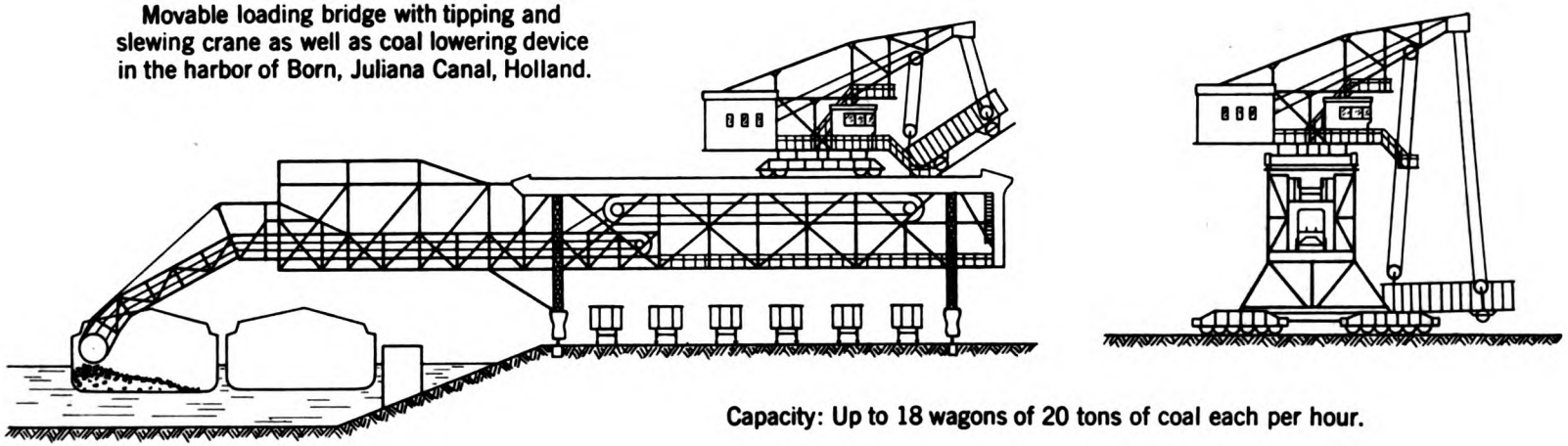
Generated on 2024-09-19 17:24 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from
THE OHIO STATE UNIVERSITY

Generated on 2024-09-19 17:23 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google



Movable loading bridge with tipping and slewing crane and coal lowering device tipping as well as working with either grabs or ordinary skeps, in the port of Bremen
Capacity: 16 railway wagons of coal per hour.

Figure 23. - Coal-handling equipment at port of Bremen.



Movable loading bridge with tipping and slewing crane as well as coal lowering device in the harbor of Born, Juliana Canal, Holland.

Capacity: Up to 18 wagons of 20 tons of coal each per hour.

Figure 24. - Barge-loading equipment at port of Born, Holland.

Digitized by Google
Original from THE OHIO STATE UNIVERSITY

27. Electrostatic Separator

At Koenigin Elisabeth colliery, the Reinstkohle plant was being equipped in one section with electrostatic separators furnished by Lurgi Apparatebau A. G., of Frankfurt.

Research on the application of the electrostatic process to the ultra refining of fine coal for special uses was undertaken by this firm as a part of the wartime development program already referred to. It appears that these researchers followed the principles embodied in early electrostatic separators exploited in America by the Huff Electrostatic Separator Co. The experimental work for the Koenigin Elisabeth plant was done at the research laboratory of Lurgi Apparatebau A. G. in Mousonstrasse, Seckbach, Frankfurt. This plant was visited November 21, 1945. There is now a small laboratory apparatus in condition to operate sufficiently to demonstrate the process; Dr. Weindel and Dr. Zopf are available at the laboratory or at the offices of the company in temporary quarters in Böhmerstrasse 10, Frankfurt.

The separating element consists of a horizontal, polished, rotating drum and, parallel to it, a filament housed in a recess in a fixed cylinder. This filament is said to produce the electrostatic field in the area between these two parallel elements by a spray of ions. The tension may be regulated in a range of 15,000 to 45,000 volts. The finely divided and closely sized coal is fed over the moving roller, which turns over towards the filament. This roller acts as a feed distributor as well as taking part in the separation. The feed is evened out on this roller by an adjustable, blade-shaped control gate.

The feed particles receive an electrostatic charge upon entering the charged area. Those having a high conductivity give up their charges immediately to the feed drum and drop vertically from it, whereas the particles of lower conductivity retain their charges longer and are carried farther around on the drum, so that they are discharged into a separate hopper.

The Lurgi specialists are of the opinion that fusain can be separated from the coal electrostatically because it has a higher conductivity than clarain and durain. Closely sized feed is essential to effective operations, and the size range was reported to be 1-1/2 to 1/10 mm.

28. Loading Coal into Ships

Leading builders of cranes, bridges, and tippling appliances for handling coal at tidewater piers are J. Pohlig A. G., Cologne, and Demag A. G., Duisburg.

The general arrangement drawings of two outstanding installations by Pohlig - one at Dresden and the other at Born, Holland - are shown in figures 23 and 24. The mechanical equipment comprises a traveling bridge spanning the railway tracks and/or storage piles, with a cantilever extension over the waterway carrying a shuttle conveyor carriage and boom section to deliver

Generated on 2024-09-19 17:25 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

into the ship's hold alongside. A crane operating on the bridge hoists the loaded car to the bridge level, where it is placed upon a tippler that pours the contents out into a small feeder hopper that delivers it to a belt conveyor in the bridge structure. This belt, in turn, delivers its load to the shuttle conveyor for delivery to the hold.

In the Pohlig system, this loading conveyor is a steel-bucket conveyor line that traverses the horizontal and inclined portions of the boom like a deep-pan bucket line, and in the adjustable vertical part it functions like a bucket elevator running backwards, taking its load at the top. Upon rounding the tail sprocket, the buckets dump their contents into the hold of the ship through the casing of the conveyor, which is open at the bottom.

For loading canal barges, as at the Born piers on the Juliana Canal, shown in figure 24, the vertical lowering section is not required. This device is reported to be effective for preventing breakage when operated carefully. It is designed particularly to handle coke, briquettes and sized coal. The capacity of these bridges is reported to be as high as 1,000 tons of coal per hour.

29. Büttner Rotary Kiln Dryer

Büttner Werke supplies an interesting innovation in the inside equipment of conventional rotary-kiln dryers, which is said to increase the efficiency. The interior of the shell is traversed longitudinally by cross-shaped (+) steel-plate shelves so arranged that the material cascades gently from shelf to shelf as the shell turns. After one complete turn from the feed end, the load is uniformly distributed among all the shelves, which are, in turn, distributed over the cross section of the shell. By this means the load is effectively exposed to the drying effect of the hot gases traversing the shell. The accompanying sketch (fig. 25) shows approximately the arrangement of shelves in section. Longitudinally, the shelves are broken into four or more separate banks (depending on the length of the dryer), each set of shelves being generally 1.80 meters long (5.9 feet).

At the discharge end of the dryer is a series of spiral guide vanes similar to the spiral feed spout of a tube mill, which delivers the dried material from the shelves to the periphery of the shell, where it is discharged.

The temperature graph (fig. 26) shows the rate of change of temperature of the dryer gases and of the load material in the dryer with the circulatory gases traversing the kiln in the same direction as the load. The upper curve shows the temperature of the gases and the lower shows the temperature of the load material. The manufacturer reports that the rapid drop in temperature in the first part of the dryer is characteristic of the Büttner design and is facilitated by the distributing vane arrangement.

30. Turbo Dryer

The Turbo dryer is extensively used for agricultural and chemical products but is also adaptable to the drying of coal where it is important to handle the load gently to avoid breakage.

Generated on 2024-09-19 17:26 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Generated on 2024-09-19 17:22 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

Digitized by Google

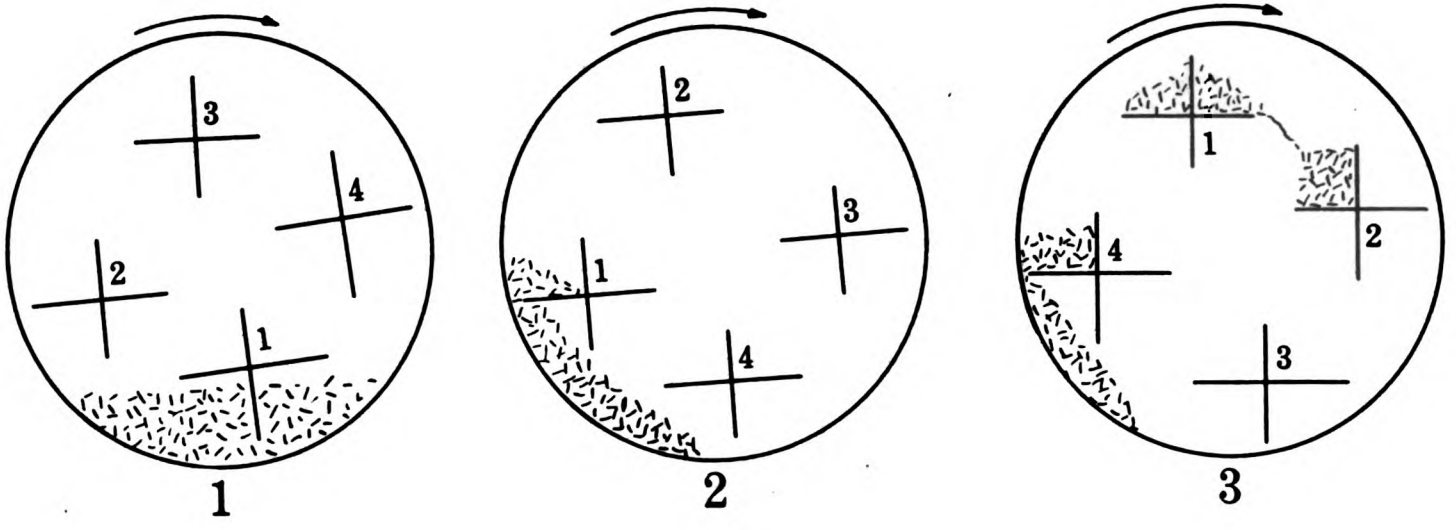


Figure 25. - Sketch showing function of internal shelves in Büttner kiln dryer.

Original from THE OHIO STATE UNIVERSITY

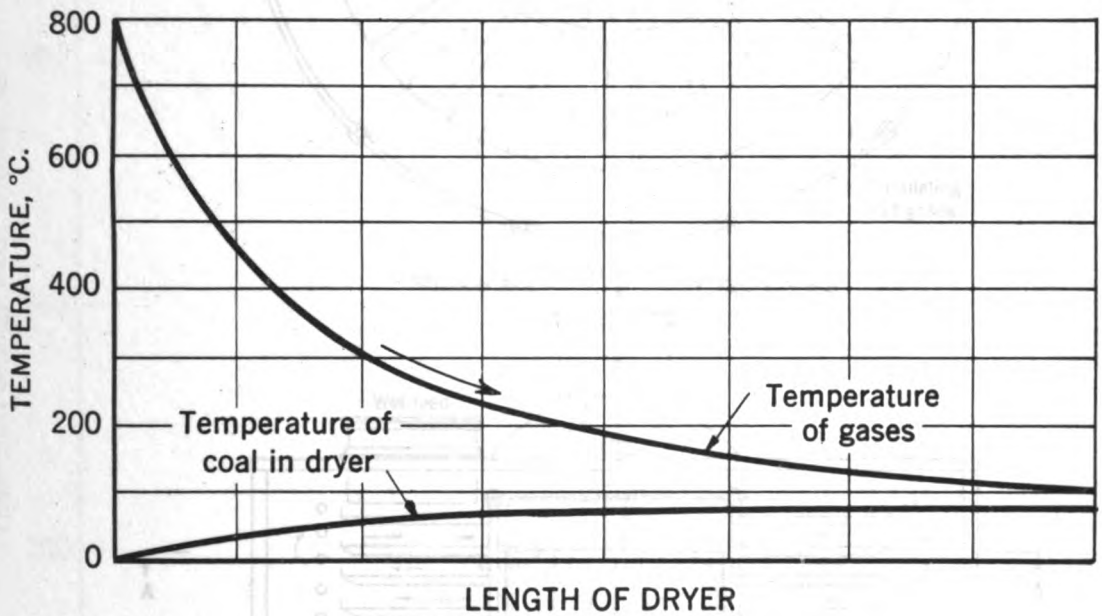


Figure 26. - Temperature graph of Büttner kiln dryer.

Generated on 2024-09-19 17:22 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

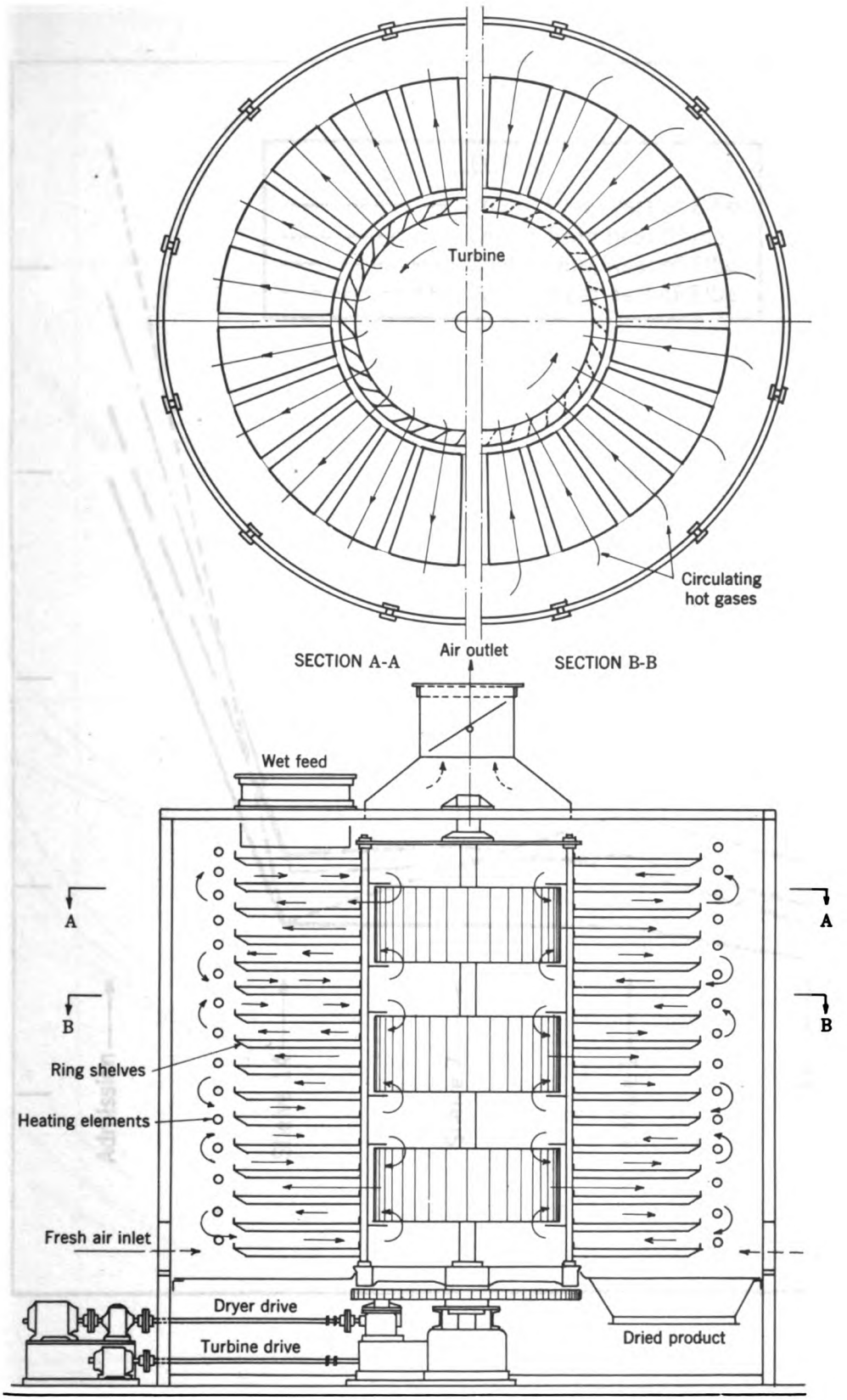


Figure 27. - Büttner turbo dryer.

Generated on 2024-09-19 17:25 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

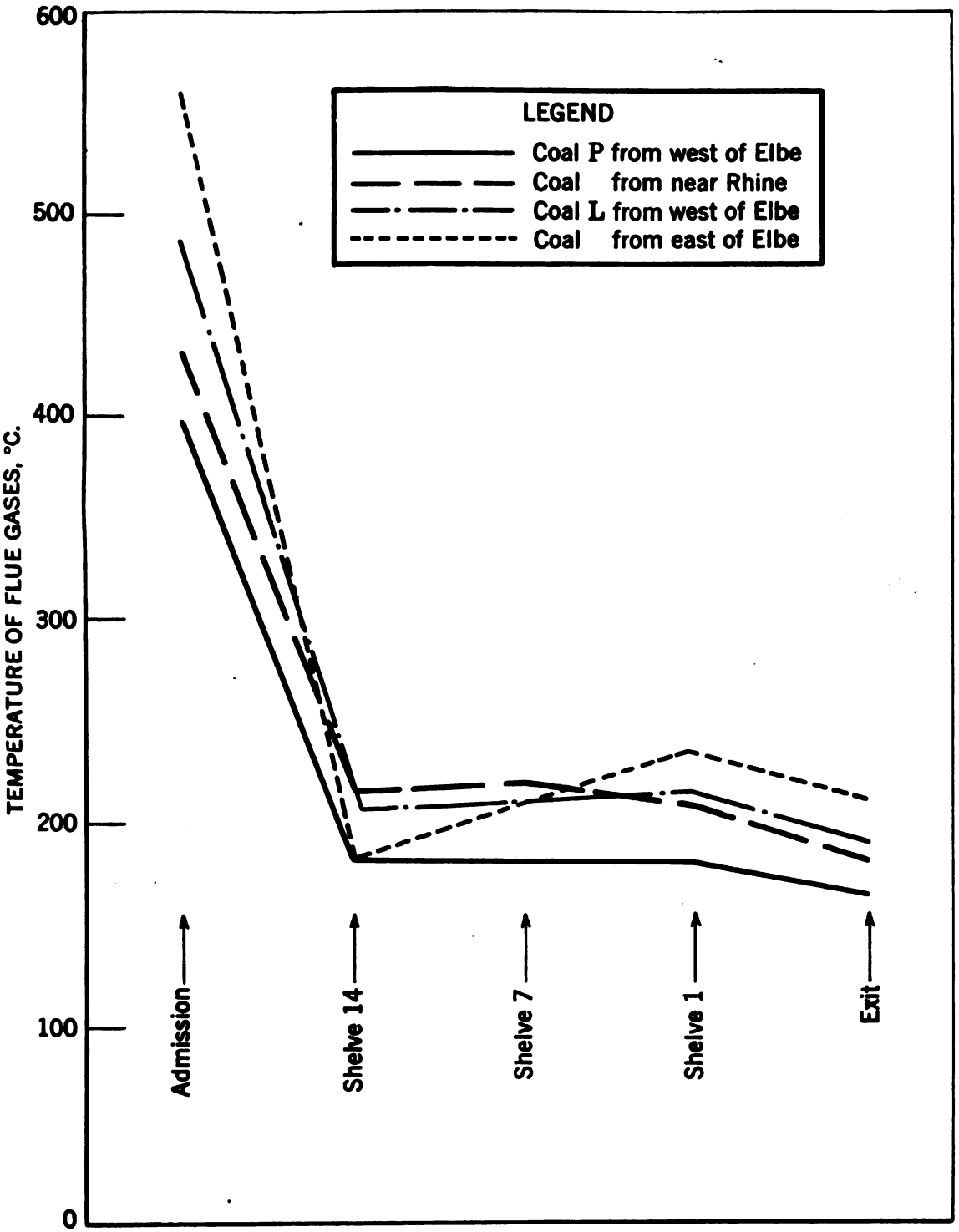


Figure 28. - Rate of temperature change of turbo dryer.

Generated on 2024-09-19 17:23 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Generated on 2024-09-19 17:23 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

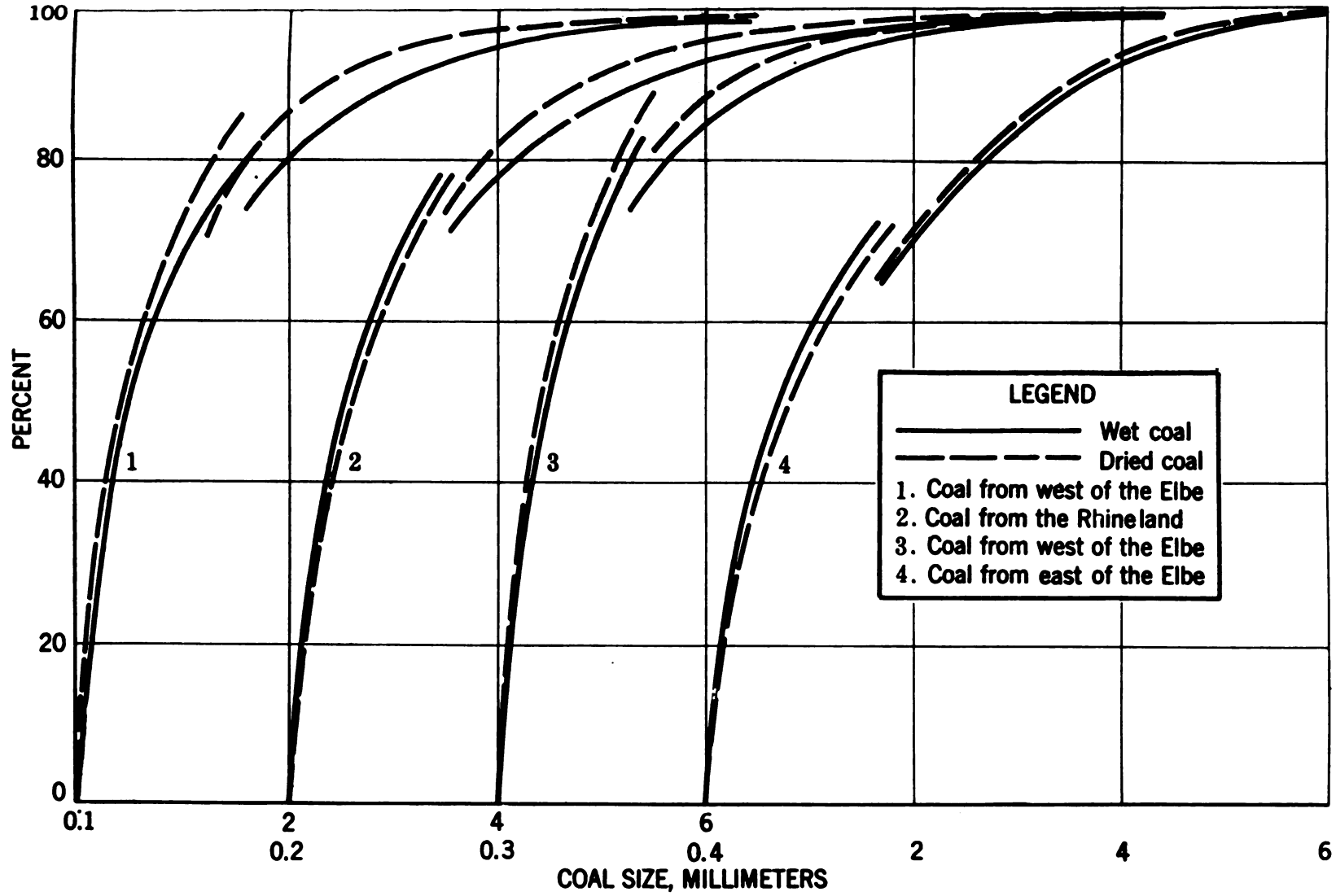


Figure 29. - Breakage of brown coal in turbo dryer.

Digitized by Google
Original from THE OHIO STATE UNIVERSITY

The dryer shell is a vertical, cylindrical drum carrying a series of ring shelves arranged one above the other and supported on a central framework around a series of turbine fans in the center that maintain a definite ventilating system. The shelf assembly rotates very slowly (10 to 15 minutes for one complete revolution). Figure 27 shows the general arrangement of the Turbo dryer.

The feed material to be dried is spread out uniformly on the uppermost shelf by a feeder above, and it progresses downwards from shelf to shelf until it is finally discharged from the lowermost shelf.

This transfer from shelf to shelf is effected by means of discharge gaps placed axially in the shelves and dividing each shelf into a number of equal segment-shaped sections separated by discharge slots staggered with respect to those above and below.

For each shelf there is a stationary, flexible discharge blade that pushes the load off the shelf segment into the discharge slot following it when the segment passes under the blade. The first blade (for the top shelf) is just behind the feeder, so that the wet coal makes one complete revolution on the top shelf; it is then scraped off into the next shelf, and the empty segment passes immediately under the feeder to receive a fresh load. There is also a spreading blade that levels off the conical pile on each shelf following the feeder.

The central fans maintain a circulation of the air in opposite directions between adjacent shelves, and the air has a generally spiral motion. Thus, if the air enters from the periphery of the drum in the lowermost intershelf section, it is drawn into the central turbine and discharged into the next annular intershelf space above, where it moves spirally outward and, at the periphery, passes upward and returns to the turbine via the next higher intershelf space. This continues until the air discharges at the center at the top at 98 percent saturation.

Where it reverses at the periphery, the drying air is reheated. In air dryers used for chemicals, foodstuffs, and the like, the air passes over heating elements there. In coal dryers, the circulating gases are heated by furnace gases or waste heat as may be available introduced through ports in the shell and distributed vertically as may be desired. Figure 28 shows the rate of temperature change of the drying gases in passing through the dryer when drying bituminous slack.

The works manager estimated 35 tons per hour capacity for drying bituminous slack from 8 percent moisture to 1 percent moisture in a dryer 10 meters in diameter by 12 meters high (32.8 by 394 feet). Expressed another way, the rate of evaporation was estimated at 1.5 to two kilos of water per square meter of drying surface per hour (0.3 to 0.4 pounds per square foot); the 10 by 12 meter dryer has 1,200 square meters of drying surface.

This dryer is reported to handle the drying of friable brown coals with very little degradation. Figure 29, reproduced from data furnished by the

Generated on 2024-09-19 17:24 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

manufacturer, shows the screen analysis of four types of German brown coals of 6 mm. top size dried in turbo dryers. In each set of curves the solid line shows the cumulative screen analysis of the wet feed coal, and the accompanying dotted line shows the screen analysis of the dried product.

Each pair of curves represents a different coal. No. 1 is identified from west of the Elbe, No. 2 from near the Rhine, No. 3 from west of the Elbe, and No. 4 from east of the Elbe.

A modification of the turbo dryer developed for handling fragile materials without transferring the load from shelf to shelf is shown in figure 30. In this design the drum is stationary, and the load is carried entirely through the dryer on a spiral conveyor. The conveyor consists essentially of a series of pans that function exactly like the segments of the shelves of the normal turbo dryer, but the individual pans are carried on a single strand of side-pull chain. Within the dryer this chain follows a spiral path downward around the inner shaft that houses the turbines. The outer sides of the pans are supported on a fixed track on the dryer frame. The entire shelf assembly is driven by the inner drum, which supports the chain track; hence, there is no movement of the chain and pans relative to the supporting frame.

At the bottom of the dryer, where the pan assembly passes out of the shell, the shelf segments, released from the outer track support, dump themselves automatically and then return to the top of the dryer to be reloaded.

Figure 31 shows the variations in moisture content of the various size increments of fine sizes of brown coal dried in turbo dryers. Data on two such samples are shown. The solid lines show the percentage of each size - size in millimeters is indicated on the horizontal scale at the bottom and screen percentages on the vertical scale. The broken line shows the moisture content of the same size fractions. Thus, in the first sample after drying, the minus 0.25 mm. fraction is 30.4 percent of the sample and its moisture content is 13.6 percent; the 0.5 x 0.25 mm. fraction is 16.2 percent of the sample and the moisture content is 12.5 percent. The average moisture of this entire sample was 14.3 percent.

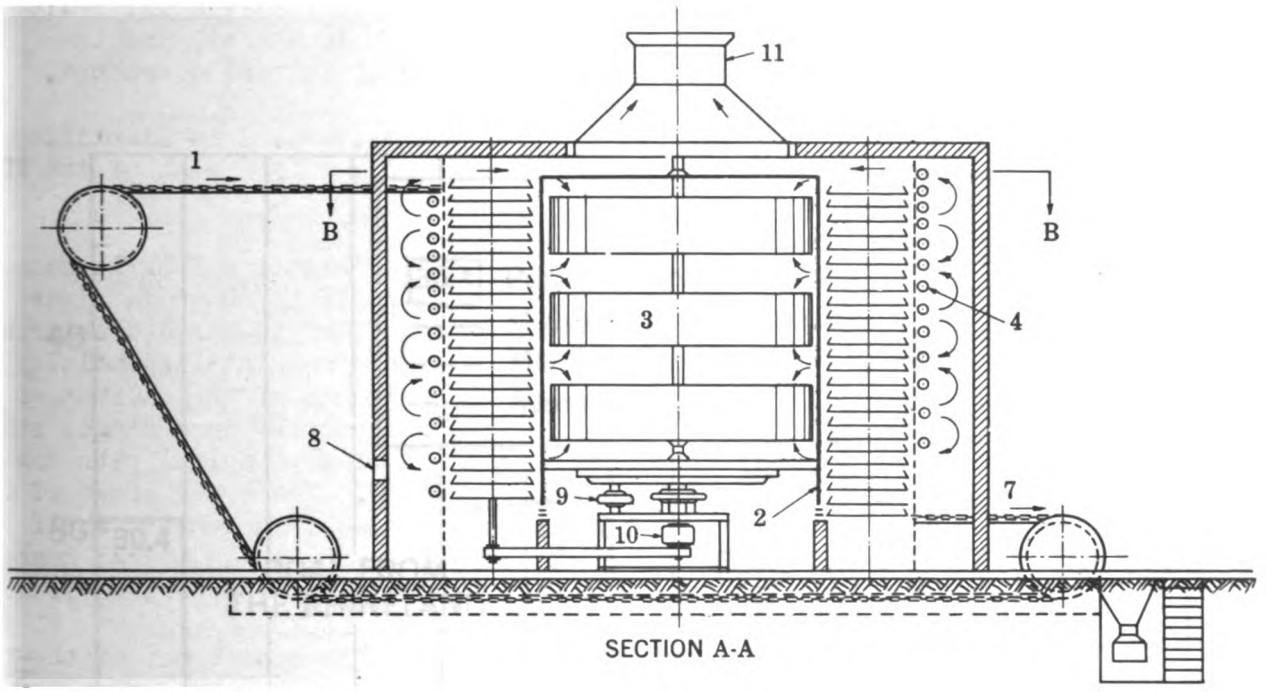
Figure 32 shows the progressive drying of the coal as it passes through the dryer from shelf to shelf (brown coal). The numbers on the bottom horizontal scale are shelf numbers from top feed shelf to bottom discharge shelf, and the vertical scale shows average moisture content. The four curves show the data on four different types of German brown coal of the same series as shown in figure 29.

31. Aspirator Dryer

The manufacturer calls this the "rapid circulation dryer", Rema-Rosin system. It is similar to the "flash" dryers developed in America.

In this system, the coal is dried and conveyed in suspension in a high-velocity current of hot gases. In the Büttner system, one exhauster is used, and the entire system operates under suction.

Generated on 2024-09-19 17:26 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY



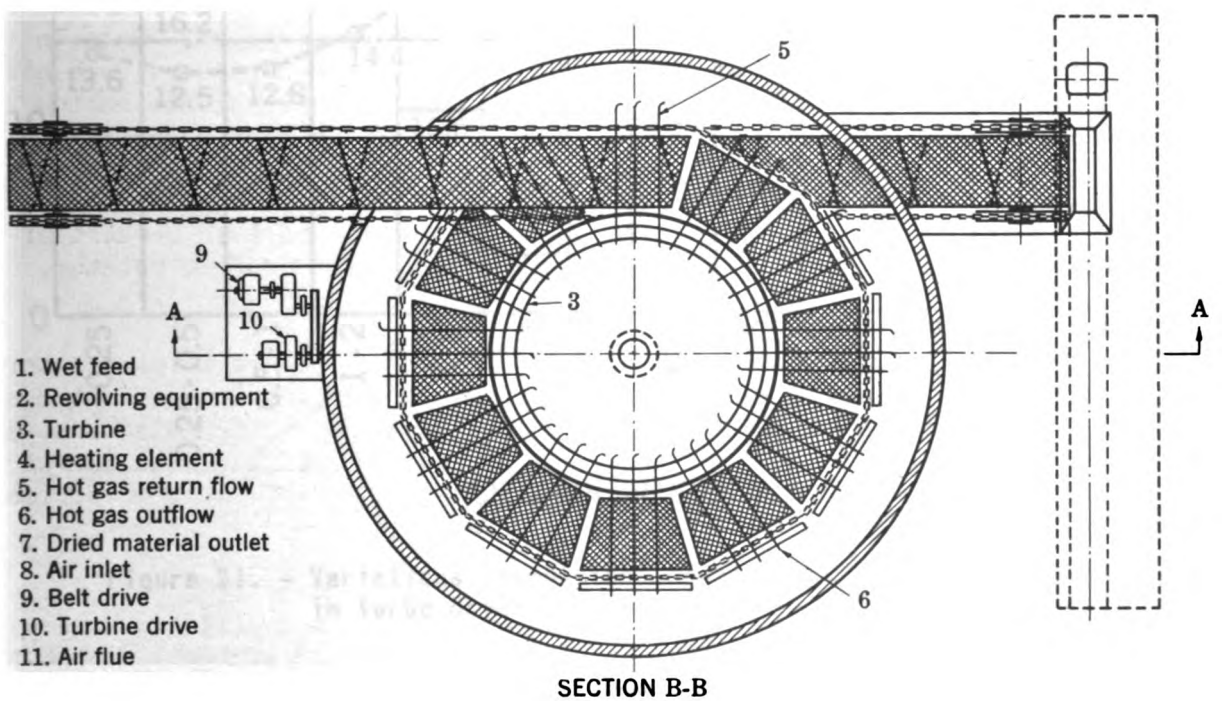


Figure 30. - Belt-type turbo dryer.

Generated on 2024-09-19 17:23 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

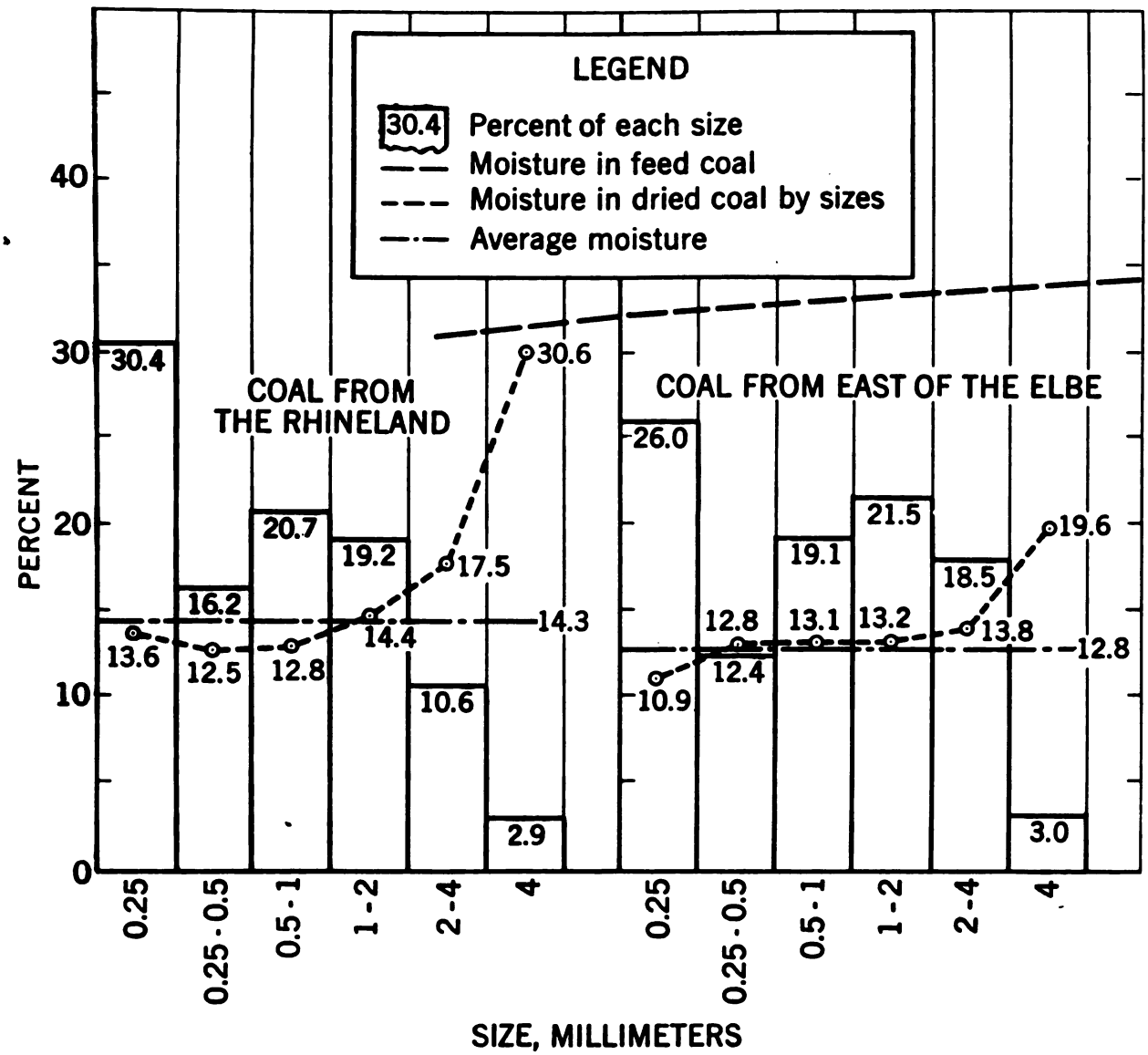


Figure 31. - Variations in moisture content, by sizes, after drying in turbo dryer (brown coal).

Generated on 2024-09-19 17:27 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Generated on 2024-09-19 17:26 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

Digitized by Google

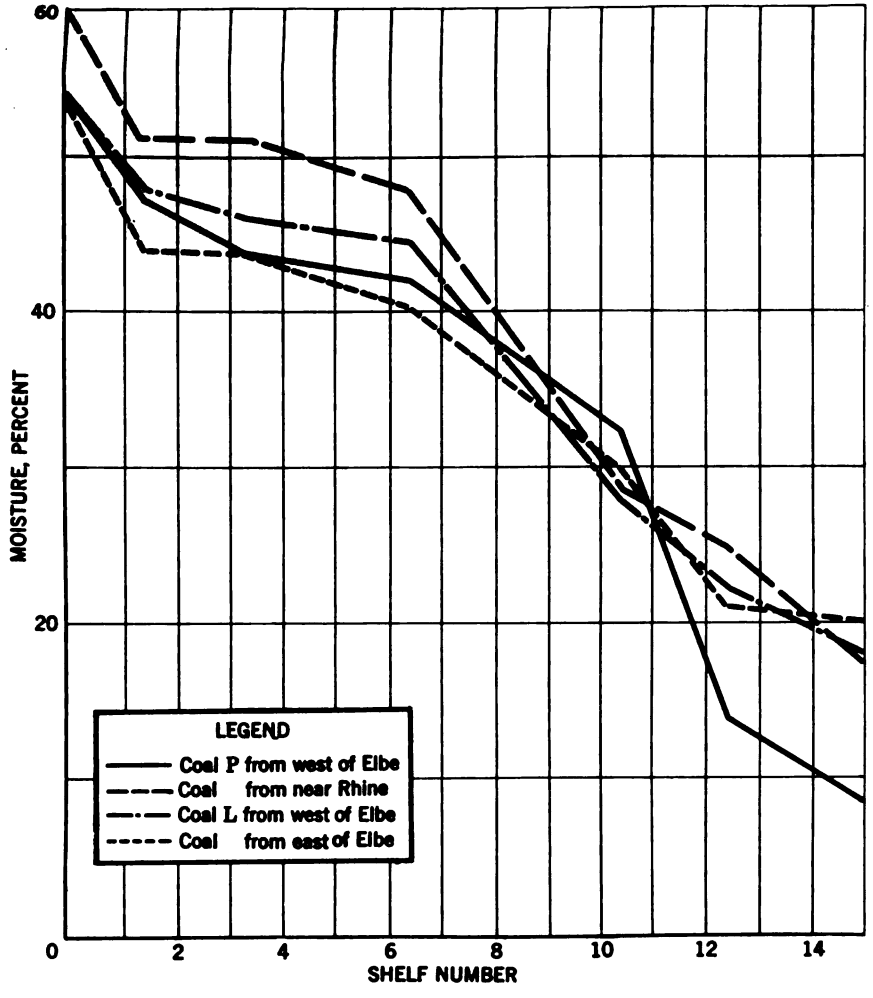


Figure 32. - Progressive drying of brown coal from shelf to shelf in turbo dryer.

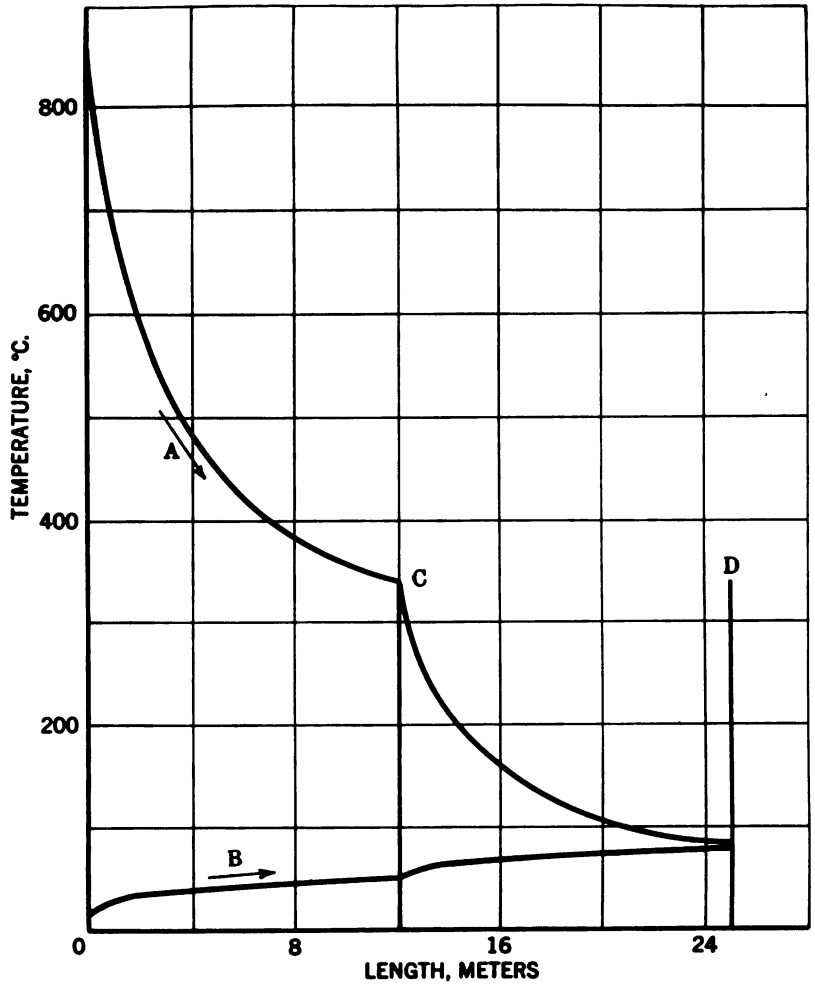


Figure 33. - Rate of temperature change in the rapid-circulation dryer.

Original from THE OHIO STATE UNIVERSITY

Hot gases from the furnace or other source are drawn into a vertical drying column, and the wet material to be dried is fed continually into a constricted section of this column (generally by a screw conveyor). The air current in the drying column dries and classifies the coal. The fine, dry coal that is light enough to be carried upward by the air current is transported over the top to a cyclone collector operated under suction by the exhauster on the discharge side of the cyclone.

The coarser or wetter particles that cannot be carried by the current, drop downwards against the current and gravitate to a mill, which crushes the coal and exposes fresh surfaces for drying. The crushed coal returns to the primary drying and classifying column or, in an alternate scheme, to a second drying column, which again delivers to a classifier. This classifier likewise delivers finished, dried, fine coal to the cyclone and returns the coarse wet particles to the mill, which thus operates in closed circuit with the drier, and automatically the system recirculates the feed material until it is dry and fine enough to pass the classifier and deliver to the cyclone.

The manufacturer cited an example of this type of dryer operating on bituminous coal at the rate of 60 tons per hour. The drying column is one meter (3.28 feet) in diameter, and the exhauster motor has a rating of 150 kw. Coal slurry of 20 to 35 percent moisture content after filtering, can be dried to around 2 to 2.5 percent moisture. Two large installations of flash driers for drying brown coal for hydrogenation at Offleben and Lützendorf have seven such units. Each of these plants handled 20 tons of wet coal per hour and delivered 13 tons of dry coal. Each dryer tube evaporates 1 ton of water per hour.

Figure 33 shows the rate of change of temperature of the circulating gases in the Flash dryer. In this graph, "l" is the length of total travel of the drying gases in meters and "t" is the temperature in degrees Centigrade. The "A" curve shows the temperature of the circulating gases, and the "B" curve shows the temperature of the load material being dried. The break point at "C" is where the recrushed coarse material returns to the dryer stream. This initiates a second phase of rapid evaporation and correspondingly rapid drop in temperature of the circulating gases.

32. Dust Collecting

In addition to the conventional cyclones and cloth filters, Büttner Werke manufactured multiple-unit cyclones under the patents of the Dutch firm of Kennemer Machinefabriek, Beverwijk, Holland, developed by van Tongeren. This is a line of metal-tube dust-collecting units similar to the "multiclone" and "polyclone" systems of the Research Corporation.

In the beginning, they installed some multiclone plants with small tubes 200 millimeters (8 inches) in diameter and as many as 680 tubes in a plant, but these early installations were found to be uneconomical, mainly because of high power requirements. The present practice favors the use of a small number of much larger tubes of 750 to 1,100 mm. diameter similar to the polyclone type. The Dutch firm of van Tongeren has installed these multicyclones up to 2,200 small tubes of 12 cm. diameter at the Central North Power House, Amsterdam.

1299

Generated on 2024-09-19 17:22 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

33. Büttner Pulverizing System

This firm had an extensive business in the manufacture and installation of coal-pulverizing systems for powdered-fuel burning.

Their standard P. F. installation consisted of a cylindrical ball mill in closed circuit with a vertical-column sorting or classifying chamber followed by a cyclone collector and exhauster on the discharge side of the cyclone.

The characteristic feature of their system is the Flash dryer in closed circuit with the ball mill, often used when the coal is damp. In such an installation, the classifying column is replaced by a Flash dryer tube. The coal feed is delivered first to the dryer classifier column where any material that is already fine enough is sorted out, dried and transported to the collector without going to the mill. The heavy particles, large and damp, go to the mill. A current of hot air is drawn through the mill to carry away and dry the coal as it becomes fine enough.

Mr. Flügel, the pulverizer expert, who has had some experience in installation of ball-mill plants for pulverizing Russian anthracites, says coals in the Charkov area are even harder than our Pennsylvania anthracites. He reports a steel consumption (including balls and lining of semimanganese cast steel) at 400 to 500 grams per ton of dry coal pulverized - higher than steel consumption in grinding cement clinker. Steel balls of 100 to 110 kilograms per square millimeter tensile strength are used.

He reports they have used pulverized anthracite for cement burning only in 50 percent mix with bituminous coals.

Büttner's large tube mills are 2.3 to 2.6 meters in diameter (inside) by 4.0 to 5.0 meters long (7.5 to 8.5 feet by 13.1 to 16.4 feet).

Generated on 2024-09-19 17:22 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

APPENDIX

Excerpts[5] from Guides for Acceptance and Supervision of Coal-Preparation Plants, Edition 1943. Technical Standardizing Committee for Mining, Part of the German Standardizing Committee

A. Definitions and Nomenclature for the Preparation Products.

I. Size Definition for Raw Coal.

1. Run-of-mine coal is the raw material as it is brought to the surface.

a. Coarse grain - the preclassified raw coal of nut I-III.

b. Middle grain - the preclassified raw coal of nut III-V. Coarse and middle grain are also designated as raw nuts.

c. Fine grain - the total grain below the smallest raw nut class (raw fine coal).

e. Finest grain - the smallest grain of the fine grain (dust or slurry, respectively). Dust falls through dry sieving or sifting as raw dust or fine dust. Slurry carries according to its origin of wet preparation processes in addition the corresponding origin designation.

II. Size Definition for Pure Coal.

6. Pure coal is the prepared coal freed of impurities.

8. "Edel" coal is an exceptionally pure coal prepared by low specific-gravity separation to obtain a lower ash coal.

9. Reinstkohle (purest coal) is specially far-going prepared coal with ash content at present below 1.0 percent.

III. Grain Designations for "Zwischen" and "Mittelgut".

11. "Zwischengut" is a process product to be further prepared. It is a mixture of intergrown with pure coal and pure refuse, which, according to grain, is designated as coarse, middle, or fine "zwischengut".

12. "Mittelgut" is an intergrown and enriched end product.

13. Nut grindings (Nuss-Abrieb) is that material that is sieved out or washed out at the nut-coal loading station. It is usually returned to the washed-coal screens.

5/ The omitted portions were considered to be relatively unimportant.

Generated on 2024-09-19 17:23 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

14. Boiler coal is that material consisting of various preparation products that is meant for the boiler plant.

V. Purity Designation.

17. Pure coal (Reinkohle), in preparatory technical sense, is a coal that is produced at a certain specific-gravity separation between pure coal and intergrown material without misdischarge, with only the belonging inherent ash content, in contrast with pure coal in fuel chemical sense.

18. Intergrown (Verwachsenes) is the so-called true middle product between the two separation gravities.

20. Misdischarge (Fehlaustrage") is the product of a concentration method which remains lighter and heavier than it should be according to the pure product. It consists of the sink particles in the washed coal and the float particles in the refuse.

VI. Moisture Definitions.

a. Surface moisture is the moisture that adheres to the outside and which, in the technique of sifting, sieving, and dewatering, is the only determining factor. (Determined according to an agreed method.)

b. Total moisture is the moisture that can be determined through 2 hours' drying at 106 degrees centigrade, whereby, during re-weighing, no uptake of hygroscopic moisture is possible.

B. Processes and Designations in the Preparation of Steinkohle.

II. Sifting (compare also DIN 7053).

2. Designations.

Missize (Fehlkorn).

a. Undersize (in sifted material).

b. Oversize (in dust).

IV. Concentration Processes.

2. Designations.

Misdischarge (Fehlaustrage").

a. Intergrown or pure refuse in the wash coal.

Generated on 2024-09-19 17:26 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

b. Pure coal or refuse in "Zwischengut" or "Mittelgut".

c. Pure coal or intergrown in the washed refuse.

Guarantees

A. Throughput

Normal throughput capacity is defined as that input per hour of raw coal with run-of-mine moisture to which the full and successful performance of all parts and auxiliary devices of the plant are to be determined. To provide for the fluctuations in the ratio of coarse grain to fine grain and to avoid too high or too low rating of single machines and devices, it is necessary to fix the maximum and the minimum charge of the coarse-grain fraction, the fine-grain fraction, and the finest-grain fraction.

In fixing the normal throughput capacity, the possibility of a sudden overload caused by unavoidable fluctuations in the hauling of coal from the mine to the plant should be covered by providing an additional ten percent of plant capacity.

The mechanical equipment of a preparation plant must be able to stand an overcharge up to 20 percent beyond the normal throughput capacity as defined above. In this case, however, the quality and the purity of the sales product must not undercut the commercial limits[6] where the middlings is regarded as a sales product.

Example

In planning a new washing plant, the throughput per hour of material to be washed, 80 mm. x 0 mm. size, had been set up (from the mining operation) at 182 tons per hour. To compensate the possibility of a severe overcharge, 10 percent is added from the side of the works managers. This results in a normal throughput capacity of the washery of 200 tons per hour. In the acceptance test, the agreed guarantees have fully to be met within a range of fluctuation of 10 percent - 180 to 220 tons per hour. Beyond that, the whole plant must not suffer any stop in case of a throughput capacity up to 240 tons per hour (possibility of overcharging the machines up to 20 percent).

In case the working circumstances indicate especially great fluctuations of charges in the preparation plant, it is well to provide a still greater possibility of overcharging the conveyors and driving motors.

B. Quality and Purity of the Products

1. Bases of Quality Guarantee.

The bases of guarantees are nature of the raw coal, interlacing curves, washing curves, and granulation of the material to be washed, all determined

6/ These limits are fixed for the western German coal-mining industry in the "Ruhr Coal Handbook."

Generated on 2024-09-19 17:26 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

by the test coal (at least 20 tons), which is furnished by the customer in a composition that should, as far as possible, correspond to the character of the raw coal to be washed. Another basis of contract is a flow sheet of methods to be used.

The guarantee for the individual products should not be based upon the quantitative output or the degree of efficiency of the plant, but upon the actual quality and purity of the products. As compared to the direct measurement of the quantities of feed and products, the determination of quality and purity of the products can be performed easier, faster, and with sufficient exactness just by examining properly collected and treated samples. These samples are tested with regard to appearance, suitability of grain, contents of ash and water, and amount of refuse material. The individual product samples furnish the fastest and most comprehensive method of valuing the success of the washing.

To ascertain the purity of products that can be obtained, it is necessary to fix on the washing curve certain separating lines between pure coal, medium coal, and refuse with the proportions for these grades, the so-called separating weights.7/ To appraise the effectiveness of any washing process, the results must be compared to the weights that correspond to these separating lines on the washability chart.

In case the raw coal is essentially changed during the time between purchase and acceptance of a plant, or in case the customer changes his requirements as to the purity of the products, the separating proportions have newly to be set up. As cases may occur in which the plant cannot be started at the preliminary fixed separating weights, it would be useful to provide in the contract a plant by which a new set of separation standards should be set up.

In such a case, the tolerance for refuse material in the product should be raised only if the new curve of intermediate material shows 1.5 times as much material in the range of 0.05 specific gravity on either side of the selected washing gravity as compared to the former curve on which the contract was based originally.

To the extent that the not-to-be-used parts are undersize grain, this has to be taken into account in the valuation.

2. Preparation of Coarse Grain and Medium Grain.

a. Classification.

7/ In case of the analysis by float-and-sink tests in heavy fluids, there are prepared by mixing bromoform (s.g. 2.89), carbon tetrachloride (s.g. 1.59), and xylene (s.g. 0.86). In case of coarse grain up to s.g. 1.85 also zinc chloride solutions can be used.

Generated on 2024-09-19 17:27 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

(1) **Dry screenings.** - At a surface moisture of the raw fine coal, size 10 x 0 mm., up to 4 percent and without complicating contents of clay[8], the size consist has to meet certain requirements.

Example

Tolerances

Grade or size	Percentage undersize	Percentage oversize	Percentage within correct size
Lump	2	0	98
Cube coal (Upper Silesia)	2	10	88
Nut I	2	6	92
Nut II	3	6	91
Nut III	4	8	88
Nut IV	5	10	85
Nut V	6	12	82
Grindings	0	14	86

3. Preliminary Classification Before Washing.

In the preliminary sizing, the allowable maximum amounts of false-size grain have to be fixed in relation to the surface moisture of the raw fine coal and to the clay content of the raw coal, as the false grain interferes with the sharp separation in subsequent washing processes. If the raw coal contains much clay, the results of screening are bad. In using jigs with feldspar bed, the raw fine coal must in no case contain oversize grain, which is larger than the perforations of the jig sieves.

Examples of prescreening

Size, mm.	Surface moisture	
	Up to 2 percent	Up to 4 percent
80 x 30	Not more than 3% undersize	Not more than 6% undersize
30 x 6	Not more than 5% false size	Not more than 8% false size
6 x 0	Not more than 6% oversize	Not more than 6% oversize

This example is true for test sievings of the undersize on round perforations with a diameter that is about 10 percent smaller than the lower limit size of grain of the respective granulation. The test of the oversize is made on sieves with round punching of normal diameter.

8/ A coal is considered strongly clayey if the sieve openings up to 6 mm. of round punching become clogged at a surface moisture of less than 5 percent, and if the sieve bottoms become incrusted on the surfaces. This happens with coals containing water-disintegrating clays.

Generated on 2024-09-19 17:30 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

4. Subsequent Classification (After Washing).

At the subsequent classification, the maximum amounts of false grain have to be fixed for each group of grain separated into undersize and oversize.

Example A

	Undersize	Oversize	Correct size
Nut I.....	2%	0	98%
Nut II.....	3%	6%	91%
Nut III.....	4%	8%	88%
Nut IV.....	5%	10%	85%
Nut V.....	6%	12%	82%
Grindings...	0.0%	14%	86%

Example B

Nut I.....	2%	0	98%
Nut II.....	3%	2%	95%
Nut III.....	4%	2%	94%
Nut IV.....	5%	3%	92%
Nut V.....	6%	4%	90%
Grindings...	-	5%	95%

Example B is valid in test sieving of undersize on round punchings with a diameter about 10 percent smaller than the lower limit size of grain of the respective granulation. The test sieving of the oversize is made on round punching of normal diameter.

5. Loading.

The nuts to be loaded (samples drawn following the loading sieves) are reviewed according to their appearance (visibly free from slates, interlaced pieces, and foreign substances)9/ and according to the false grain and the amount of small coal. The samples of the respective grain groups must contain not more than a specified maximum amount of false grain. It is particularly important that the sized coal be free from fines: Fines is defined as a coal of a size of 6 x 0 mm. In case of nut V, the small-coal guarantee has to be omitted.

Examples of Nuts Loaded According to the Size of Grain

Example A

Nuts I to III, 80 mm. to 18 mm., not more than 10 percent of undersize, of the undersize not more than 0.5 percent of fines.

9/. For example, wood and paper, insofar as special devices for removing foreign substances are provided in the contract.

Generated on 2024-09-19 17:29 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

In nuts IV and V, 18 mm. to 6 mm., not more than 15 percent of undersize, of this undersize limited to 5 percent slack (in case of nut IV).

Example B

Nuts I to III, 80 mm. to 18 mm. not more than 5 percent undersize, of the undersize limited to 0.5 percent fines.

In nuts IV and V, 18 mm. to 6 mm., not more than 8 percent undersize, of this undersize limited to 5 percent fines (in case of nut IV).

Example B is true for test sieving the undersize on round punchings with a diameter about 10 percent smaller than the lower limit size of grain of the respective granulation. The oversize is tested on a roundly punched sieve with normal diameter of the perforation.

b. Washing (Concentration).

(1) Wet Washing.

(a) Clean coal. - In the clean coal following the washers, the allowable maximum amounts of pure slates (Reinberge) and interlaced material (not usable coal, misplaced) referred to the agreed separating gravity are to be fixed and guaranteed. Samples of the washed coarse grain and medium grain shall be drawn directly following the respective washers.

In case of heavy-liquid methods, the allowable weight fluctuation of the separating liquid is to be fixed.

Examples of Purity with a Proportion of Interlaced Material of Not More Than 12 Percent in the Input

In case of coarse grain 80 mm. x 18 mm.

	At jig and trough washeries			At heavy-liquid washeries	
Pure coal.....	95	97	98.2%	98	99.4%
Intergrown material..	4	2.5	1.6%	2	0.6%
Pure refuse.....	1	0.5	0.2%	Free from refuse	

In case of granulation 18 mm. x 6 mm.

	At jig and trough washeries			At heavy-liquid washeries	
Pure coal.....	94	95	97.2%	97	98%
Intergrown material..	4.5	4	2.5%	3	2%
Pure refuse.....	1.5	1	.3%	Practically free from refuse	

(b) Zwischen and Mittelgut10/. - At jig washeries and trough washeries, the content of true medium coal in the middlings product

10/ In planning and designing new plants, the possibility of installing a colliery power plant has to be regarded, insofar as it concerns the production of a middling or the further treatment of intermediate near gravity coal.

Generated on 2024-09-19 17:26 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

often amounts to 50 to 60 percent when the proportion of intergrown material in the input is 4 to 12 percent. If the input contains more than 12 percent of intergrown material, heavy-liquid washing should be considered.

In heavy-liquid washing, the minimum content of true medium coal in the middlings product should be not less than 90 percent in the case of coarse grain and not less than 85 percent in the case of medium grain, with the raw coal containing at least 3 percent of intergrown material. The lower limit size of the medium grain, then, must be higher than 10 mm. If the lower limi of the medium grain is about 6 mm., the content of medium coal should be not less than 80 percent.

It is useful to specify also the proportion of pure slate in the middlings. The proportion of slate should not be higher than that of pure coal.

(c) Refuse. - The slate of the washers shall contain no more than X percent of pure coal and Y percent of intergrown material referre to the agreed separating gravities.

Example of guarantee where the amount of intergrown material in the input is not more than 12 percent

	At jig and trough washeries				At heavy-liquid washeries	
	Coarse grain		Middle grain		Coarse and medium grain	
Pure refuse.....	96	94 95.5%	96	94%	96	98%
Intergrown material..	3	5 4.0%	3.5	5.3%	4	2%
Pure coal.....	1	1 .5%	.5	.7%	Practically free	

(2) Dry cleaning. - No equally high demands, particularly with regard to the intergrown material in the middling product, can be applie to coarse-grain dry cleaning if air jigs or tables are used. So it is enough to fix only a general figure for float in the dry slate and sinks in the dry coal. For the intermediate product in general, the slate content is specified. It is necessary to specify the coal content only when a middling product is to be returned continually to the feed.

Example

Air jig or table plant for 50- x 10-mm. coal

Clean coal.....	94 to 96% pure coal.	4 to 6 % slate and bony.
Intermediate coal	Max. 60% pure coal, min. 20% bony.	Max. 20% slate.
Refuse.....	90 to 92% slate.	8 to 10% coal and bony.

3. Washing of Fine Grain.

a. Sizing Finest Grain by Screening or Sieving.

(1) Sorting. - In separating the finest grain from the raw fine coal by sorting or sieving, the allowable maximum amounts of coarse

Generated on 2024-09-19 17:23 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

grain in the dust and of fine grain in the dedusted coal have to be fixed for the agreed grain separation, which generally is between 0.2 and 0.5 mm. This guarantee has to be referred to a certain content of dust in the input and to a limiting surface moisture in the 6 x 0 mm. grain. It may be necessary, also, that the clay content of the finest grain should be taken into consideration.

Examples of sifting of 6- x 0- mm. coal

Moisture in feed, percent	Undersize in dedusted product, percent			Oversize in dust, percent		
	Under 2	2 to 3	3 to 5	Under 2	2 to 3	3 to 5 1/
Dust in feed:						
Under 15.....	2 to 3	3 to 4	7 to 8	15 to 17	18 to 20	23 to 25
15 to 20.....	3 to 4	4 to 5	9 to 11	12 to 16	15 to 19	21 to 24
Over 20.....	4 to 5	5 to 6	11 to 13	10 to 15	12 to 18	19 to 23

1/ Examples true of coal from Upper Silesia.

(2) Predusting. - If preclearing from dust is provided as an addition to or as a substitute for dry finest grain sifting then, on the preclearing the content of finest grain remaining in the cleared coal and the oversize in the dust is to be guaranteed.

Examples of pre-clearing from dust at 0.5 mm. grain separation

	Percent	Percent
FE (fine grain in the cleared coal)..	4	6
GS (coarse grain in the dust).....	20	16

b. Enrichment (Washing).

(1) Wet Washing the Fine Coal.

(a) Washed coal. - It should be guaranteed that the washed fine coal (larger than 0.3 mm.) should not contain more than X percent of intergrown material and Y percent of pure slates, referred to the agreed separating gravities.

To obtain an economically advantageous addition of finest grain to the washed fine coal, the fine grain-washing devices must be able, with respect to grain greater than 0.3 mm., to deliver products of different ash contents to suit varying conditions, and these have to be fixed according to the requirements. For these sizes, it may be necessary to agree on several alternate separation gravities and several sets of tolerances.

Examples of washed-coal specifications

	Jigs				
	Main washing			Rewashing	Launders
Pure coal.....	95	96	97.4%	90%	96%
Intergrown material...	4	3.5	2.3%	8%	3.5%
Pure slate.....	1	.5	.3%	2%	.5%

Generated on 2024-09-19 17:23 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

(b) Intermediate (zwischengut) and medium (mittelgut) coal. - The fine-grain intermediate product of the main jig is given the name "medium coal" (mittelgut) only when it will not be rewashed subsequently. Otherwise, a finished medium coal is obtained only at the rewashed jigs. Besides washed coal from the rewash, rewash refuse and, if necessary, feedback or return material must be specified. The medium coal and the intermediate coal have to be guaranteed upon the basis of minimum percent of true medium coal as determined by the intergrown material in the raw fine coal or in the input feed to the rewashers. With more than 4 percent true middlings in the raw fine coal, the content of pure coal in the medium product of the subsequent washing should be 50 to 60 percent.

When there is a subsequent rewashing, a guarantee of the intermediate coal of the main washing can be waived. If there is no subsequent rewashing, the medium product should contain at least 25 percent of intergrown material if 4 to 12 percent of it is in the input.

Examples for the composition of the middle product of the main fine-grain jig

Intergrown material in feed	6.0	6.3%
Pure coal	28.4	31.3%
Intergrown	40.6	35.0%
Pure slate	31.0	33.7%

Slates

The guarantee is that the fine slates greater than 0.3 mm. of each machine separately are not allowed to contain more than X percent of pure coal and Y percent of intergrown material with relation to the agreed separating gravities.

In order to reduce the discharge of coal slurries with the fine refuse, it is to be demanded that in new installations, or when simultaneously guaranteeing the wash-water clarification, the ash content of the fine refuse as it is represented through the grain part below 0.3 mm. should not be reduced more than 1 percent in old installations, a maximum of 2 percent.

Examples

	Jigs						Launders
	Main washing			Rewashing			
Pure slates	94	96.6	97.6%	90	92.8	94.8%	95.0%
Intergrown	5	3.0	2.4%	8	6.8	5.2%	3.5%
Pure coal	1	0.4		2	.4		1.5%

2. Dry Cleaning

No equally high requirements can be made for the dry cleaning of fine grains, especially with respect to the composition of the middle product. In general, it is satisfactory to specify the delivery of pure dry slate and

Generated on 2024-09-19 17:23 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

recycled coal and cleaned dry coal. So, for dry cleaning it is enough to guarantee fixed tolerances for false particles in the clean coal and the refuse. For the intermediate product, however, only the proportion of slate can be guaranteed.

Examples

(a) For air jigs and tables on 10 x 3 mm. grains

Clean coal.....	3 to 5% slate and bone	95 to 97% pure coal
Middlings.....	15% slate	85% bone and coal
Slate.....	92 to 95% slate	4% bone and coal

(b) For air jigs and tables on 3 x 0.5 mm. grains

Clean coal.....	5 to 7% slate and bone	93 to 95% pure coal
Middlings.....	15% slate	85% bone and coal
Slate.....	96% pure slate	4% bone and coal

(c) Fine-grain dewatering

1. The allowable average water content[11] of the washed fine coal can be guaranteed for dewatering devices only by relation also to the draining time. Moisture guarantees thereby can be made only for surface moisture, because this can be removed mechanically.

Examples

(a) Where fine coal has been precleared of dust, 8 percent after 18 hours time of standing.

(b) At dripping towers, 9 percent after 24 hours of standing.

For the fine-grain dewatering in centrifuges it is useful to fix the following guarantees:

1. The quantity per hour of centrifuged coal indicated on dry weight basis.

2. The average water content of the centrifuged coal.

3. The quantity per hour of centrifuged sludge, indicated on the dry weight basis and in grains per liter.

4. The energy in kw.h./t with respect to the dry weight of the centrifuged coal.

11/ According to DIN 21934, older coal (anthracite to fat coal) contains less than about 1 percent moisture in air dry state, gas coal contains 1.6 to 3.0 percent, gas flame coal 2.8 to 6 percent, and flame coal more than 6 percent.

Generated on 2024-09-19 17:22 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

These guarantees then have to be related to certain characteristics of the input coal with regard to:

(1) Water content.

(2) Grain composition of the centrifuge input.

(3) Ash dispersion, particularly clay content.

(4) Method of preliminary dewatering.

For example, with an input coal of 20 to 30 percent moisture, 12 to 15 percent of finest grain under 0.5 mm. size and without aggravating clay content[12] the following guarantees would be appropriate:

1. Throughput 50 tons per hour of centrifuged coal (dry weight).

2. Surface moisture average 8 percent.

3. Throughput loss up to 5 percent referred to dry input.

4. Consumption of 0.4 kw.h./t of dry input.

2. The Middlings.

For the dewatered middling, a guarantee of maximum average water content can be undertaken after fixing the draining time.

Example

Eleven percent of average surface moisture in the dripping tower after 24 hours of standing.

IV. Handling of Finest Grain.

(a) Slurry Sieving

In handling the slurry by sieving, it is customary to guarantee the undersize grain in the sieve overflow (coarse slurry) and, if necessary, also the content of oversize grain of the sieve run through.

Example for slurry screening at a separating grain size of 0.3 mm.

GS (coarse in the fine sludge, sieve run through)	15 to 18 percent.
FE (fine in the coarse slurry product)	20 to 25 percent.

12/ An aggravating clay content would suppose the granulation under 0.075 mm. size to contain more than 25 percent of ash and amount to more than 10 percent of the solid substance of the feed.

Generated on 2024-09-19 17:22 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

(b) Froth Flotation

In cleaning slurries by flotation, the throughput (dry coal in tons/hour) and the consumption of reagents (in grams/ton solid material in the raw sludge) can be guaranteed. It is usual to fix in the contract, also, a given ash content of the input coal, the maximum ash content of the cleaned coal, and the minimum ash content of the slate, depending on whether or not a middle product is to be made. Because of the disadvantageous influence of the oversize grain, it is necessary to fix the upper grain limit of the input coal. It is usual to fix the amount of the grain greater than 0.5 mm. as well as the ash contents of this grain. The results are very different, depending on the nature of the raw sludge and the reagents used. Therefore, guarantees for flotation can be agreed upon only after special researches are made.

Example

For 0.75 x 0 mm, no grain greater than 1.0 mm., ash content 25 to 30 percent, the clean coal should contain not more than 6 to 7 percent of ash, the slate should contain not less than 60 percent of ash when a middle product is not made. For consumption of reagents refer to the "Merkblatt über die Einsparung von Flotationsölen bei der Schaumschwimmaufbereitung der Steinkohle," edited by the Bergbau-Verein (Mining Association), Essen.

Example of the effect of size consist of the feed coal

	Percent	Percent
Proportion of grain greater than 0.5 mm. in the slates	22.2	2.8
Ash in the grain greater than 0.5 mm	57.3	25.9
Ash in the grain smaller than 0.5 mm	66.3	75.7
Average ash of the slates	64.3	74.3
Deviation of the ash content of the grain greater than 0.5 mm. from the average ash content	7.0	48.4
Decrease of the ash content of the grain smaller than 0.5 mm. by the grain greater than 0.5 mm	2.0	1.4

(c) Filter Operation

In filter operations it is usual to guarantee the filtering rate in dry weight of filtered sludge in tons per square meter per hour, the water content of the filter cake, and the allowable solid matter in the filtrate. The specifications must be related to the finest grain content of the input, the pulp density (grams/liter), and, if necessary, the ash dispersion.

Generated on 2024-09-19 17:26 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Example (for unfloated sludge)

Suppositions	Guarantee
Not more than 20 percent under 0.075 mm.	Power 0.5 t/m^{2}h
Density of the pulp about 350 grams/liter	Surface moisture less than 22 percent
Without aggravating clay content13/	Solid material in the filtrate less than 20 g/l

V. Breaking and Grinding

For the disintegration of lump coal, for the grinding of nut coal, for the production of finer nut sorts from washed coarser nuts, for the breaking of intermediate sizes, or for the mixing grinding of coking coals, it is usual to fix the throughput rate and the grinding of fineness or the degree of breaking, respectively, by fixing the minimum proportion of the desired grain and the allowable quantities of additional oversize grain and of undersize grain.

Examples

(a) For breaking lump coal not more than 5 percent over 80 mm. (3.1 inches) and not more than 15 percent under 10 mm. (0.39 inch)

(b) For breaking nut coal.

(1) Production of small nut sorts out of washed coarse nuts, not more than 15 percent over 18 mm. (0.7 inch) and not more than 25 percent under 10 mm. (0.39 inch).

(2) Production of coking or briquetting coal, respectively, out of washed nut sorts, not more than 10 percent over 6 mm. (1/4 inch) and not more than 20 percent over 3 mm. (1/8 inch).

(c) For crushing middlings.

(1) Coarse middlings 80 x 30 mm. (3.1 x 1.2 inches), not more than 10 percent over 30 mm. (1.2 inch) and not more than 7 percent under 0.5 mm.

(2) Medium-grain middlings 30 x 10 mm. (1.2 x 0.39 inch) not more than 40 percent over 10 mm. (0.39 inch) and not more than additional 11 percent under 0.5 mm.

(d) For mixing grinding.

The finished coking-coal mixture out of the rinsed fine coal and the ground nuts is to contain:

13/ A more difficult condition is to suppose the granulation under 0.075 mm. shows more than 25 percent ash and amounts to more than 10 percent of the solids.

Generated on 2024-09-19 17:27 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

For fat coal, at least 80 percent under 3 mm. (0.12 inch) granulation.

For gas coal, at least 95 percent under 3 mm. (0.12 inch) granulation.

VII. Finished Fine Coal.

A guarantee for the average ash content and surface-moisture content of the final fine coal and for the quantity of added finest grain can be fixed only when the responsibility for the handling and distribution of the constituent products and of the process of washing is vested in the contractor. Special guarantees must be agreed upon concerning the grain fineness and the uniformity of the total moisture content, if, at the coking coal washeries, mixing and grinding plants are also included in the contract.

Examples

(a) Grain fineness for the coking coal mixture without addition of ground nut coal, at least 80 percent under 2 mm. (0.08 inch).

(b) Allowable fluctuations of the total moisture content of the mixture up to 1.0 percent.

VIII. Wash-Water Clarification.

In regard to the clearing of wash water, guarantees can be fixed for the various circuits - ordinarily for main washing water, the rewash water, and the waste water clearing, separately. The guarantees should cover the solids allowable in the cleared wash water. No sludges containing useful coal or middlings should leave the plant. Further, there should be no less of any wash water (except together with the final products or by vaporization), except where an unusually high content of sodium chloride or surplus water from the nut sprays forces such a loss.

Examples of allowable solids in the clarified water, in grams per liter

	With clay-rich coal	With clay-lean coal
In the main washing.....	Not more than 40 to 60	30 to 40
In subsequent washing.....	Not more than 50 to 70	40 to 60
In the wash water (after 1½ hours of standing).....	Not more than 0.5 cm^3/l	0.5 cm^3/l

Room Dedusting.

The room dedusting is to prevent dust losses and to keep the plant and plant atmosphere clean. The size of the room-dusting equipment has to be fixed according to the surface moisture of the raw coal.

Within 24 hours the deposit of dust on places, which have to be agreed upon, must not be more than 5 grams per square meter of horizontal plane. The vented air should be visibly free from dust.

Generated on 2024-09-19 17:23 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

C. Other Guarantees.

1. Working expense.

The working expense has to be guaranteed per ton of mine-moist input material. It is to be subdivided into:

(a) Energy.

The need of current for washing plants should amount to not more than 4 kw.h./t without filtration, grinding, centrifuging, froth flotation, or room dusting when working at 20 percent overcharge in excess of the guaranteed throughput. At plants handling only fine grain, the need of energy is allowed to be higher.

(b) Heavy-suspension plants.

Heavy-liquid plants guarantee the expense for material used to make the suspension.

(c) Fresh water.

Particular care has to be taken to save fresh-water consumption. Fresh water should be used, if possible, only at the following places: Nut spraying, packings at pumps, laboratory cleaning, and cooling of the water-ring pumps at filtration and flotation plants.

II. Specifications of Quality for Machines and Auxiliary Apparatus.

Where no standard conditions exist, the specifications of the purchaser shall be taken as the basis of negotiation. The same is true for the building materials to be used and for the construction of the buildings for the preparation plant.

III. Protection Against Patent Infringement.

It is recommended that provision be made in the guarantee conditions for protecting the purchaser against unauthorized use of patents valid or applied for or of registered designs.

IV. Tolerances.

The guarantees shall be considered without tolerance; i. e., they shall be unconditional maximum or minimum values. If a tolerance is reserved, it must be positively stated in the guarantee agreement.

V. The Acceptance Test.

In the guarantee agreement there must be a specification of the time, kind, number, and duration of the particular tests for the guarantee and provision, also, for settlement in case the guarantees are not fulfilled.

Generated on 2024-09-19 17:27 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

The formal acceptance test may be waived if the operating results of 14 days correspond, on an average, with the required guarantees; but the overload test must be carried out separately.

It is necessary to provide, in the construction plans, for facilities for satisfactory sampling. The contractor must demonstrate that the agreed-quality promises for the prepared products are really attainable when the plant is operated. He must provide sampling places that are accessible, and it must be possible to take authentic (especially not disintegrated) and satisfactory samples by appropriate sampling utensils and sampling places provided in the plant design.

The contractor must be allowed adequate time for adjustment and adaptation of all particular equipment between the time of starting the plant and the performance of the acceptance test of the preparation plant or of any particular pieces of equipment.

Acceptance Tests

A. Preparation During the Practicing Period.

During the several weeks of practicing preceding the acceptance tests, the purchaser must be currently informed of the preparation results. The successful operation of the most important working processes during this period shall be seen therefrom. The supervising and attending personnel shall be trained during this time.

The selection of particular working processes to be currently examined and supervised everyday during the practicing period follows from the specific guarantees fixed by agreement. Besides, there is recommended an examination of intermediate processes of screening, crushing, concentration, dewatering, clarification, etc., so far as the results have essential influences on the final products, or a separate test of the operations shall be provided for at a later date. In this case, it is necessary to provide also here for the necessary accessibility and sampling facilities.

B. Performance of Acceptance Tests.

I. Acceptance Plan and Load.

The acceptance test is usually carried out jointly by the purchaser and the contractor according to a plan previously agreed upon as soon as the technical conditions therefore are exactly examined in all details. The purchaser decides how the plant shall be operated for the acceptance test within the agreed acceptance plan; how long the test shall last, and whether all samples shall be taken simultaneously when a signal is given or groupwise, successively, when going round; how the samples shall be processed and evaluated; whether the samples shall be tested at once, or in what way the particular samples shall be stored.

Generated on 2024-09-19 17:24 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

When proving the guarantees, the throughput must be adjusted to the rated capacity as exactly as possible; inevitable deviations up to ± 10 percent are admissible and, beyond that, short overloading and underloading peaks. If the load deviations are greater, and if there is no possibility of compensation, the acceptance test must be interrupted until the normal throughput is reached again and the under or overloading effect has had sufficient time to slow down.

II. Duration of the Acceptance Test. Frequency and Validity of Sampling.

If there are no abnormal results, no strong deviations of operating conditions due to insufficient facilities for mixing, bunkering, or compensating as to variations of quantity, granulation, and ash of the material to be processed, and if sampling is not too extended, acceptance tests can be carried out on one test day during the main output time uninterruptedly for at least 4 hours. Otherwise, it is necessary to carry out the acceptance tests during several days in the same way, and, if necessary, to separate the sampling according to the separable groups.

When the acceptance test is continued for several days, the collected samples of each day shall be evaluated daily, if possible, in order to prevent failing of the acceptance tests, because the quantity of the particular samples cannot be satisfactorily controlled or because the individual packing and safe storage of the samples is too difficult.

All receptacles for collecting samples must be provided with a sample card; they must be well-marked outside and still be portable. The smaple card is left with the sample after emptying the container. The sample containers shall be set up as near as possible to the sampling place and as far as possible from other collecting receptacles, so that mistakes about sampling will not occur.

Missed or rejected samples cannot be made up by a more rapid sampling, because the material conformity with the other samples would not be maintained. If there are disturbances or too high a surface moisture, sampling is discontinued as long as the interference with the method of working of the preparation machine in question lasts.

Sampling places must be clearly marked by the sample number, and the particular quantity and frequency for the sampling in question must be noted.

III. Sample Quantities.

With a sampling sequence of 10 minutes, 24 samples are obtained in a test time of 4 hours. In this case, the gross samples will amount to 24 times the quantity of the single sample increments. If smaller gross samples are sufficient, it must be decided in every case whether the single sample increments shall be taken in a smaller quantity or at longer intervals.

Generated on 2024-09-19 17:25 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

The minimum amounts of gross samples for oversize or undersize in screened products or for determining floats in the refuse and sinks in the coal should amount to 0.025 to 0.5 percent of the feed. The smaller number relates to great quantities of material or to a uniform quality, and the larger number to small quantities or nonuniform quality.

The minimum quantities, in kilograms, for float-and-sink tests shall amount to:

Size, mm.	Raw coal	Prepared coal	Middlings	Refuse
80 x 10 (6)	250	-	-	-
80 x 50	150	30	35	40
50 x 18	50	12	15	20
18 x 10 (6)	12	3	5	10
10 x 1	5	2	3	5
Below 1	0.5	0.3	0.3	0.5

For intermediate grain ranges, middle values are to be taken. Visibly pure refuse may be weighed without test floating, but not pure coal and intergrown material (Verwachsenes), because the appearance may be deceptive in these cases.

With fine-grain material, washing curves and intergrown curves (Verwachsungskurven) as well as float-and-sink tests are made with material screened over a 0.3 mm. screen.

The minimum quantity[14] of the collected samples for test screening and incinerations[15] shall amount for both raw coal and prepared grain to:

Grade	Size, mm.	For screening, kg.	For incineration, kg.
Raw coal	80 x 0	500	150
Do.	80 x 10 (6)	350	150
Grain	80 x 50	50	40
Do.	50 x 18	30	40
Do.	18 x 10	10	40
Do.	10 x 6	7	40
Intermediate material	80 x 10 (6)	65	300
Tailings	80 x 10 (6)	80	200
Fine grain	10 x 0	8	40
Do.	6 x 1	5	40
Do.	1 x 0.5	1	10
Finest grain	- 0.5	0.3	10

The utensils for carrying out float-and-sink tests and screen tests shall be, if possible, the same as are used later on for plant control. The

14/ The indicated quantities correspond with those currently followed in operating practice, but they are cases that are different from the theoretically necessary quantities.

15/ The prescriptions of DIN 53711 and DIN DVM 3712 are to be applied accordingly.

Generated on 2024-09-19 17:29 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

crew shall be practiced in the handling of the utensils and become acquainte with the test methods. Therefore, it is best to complete the equipment of the laboratory for plant control before starting the preliminary experiments.

C. Examination and Evaluation of Samples. Directions for Test Screening.

I. General.

It shall be proved by screen tests how far the screening and sifti equipment has separated the material correctly into the different grain classes. Every screen test can, especially in the case of soft coal, produc additional breakage which obscures the result by a higher yield of undersize than is found in reality. When defining the admissible portion of undersize it is therefore recommended to consider that fact. Controversies because of the abrasion that cannot be determined practically in a reliable way shall then be expressly avoided. It is also advisable in the case of soft coal to screen out first the grains greater than 1 mm. so that they may not be expos to additional abrasion during the whole time of test screening.

II. Taking and Preparing Samples.

The samples for the test screening shall be taken as good average samples during a sampling time of several hours when fully operating in previously fixed times and quantities. Sampling is done immediately at the overflow of the screen before the next bunkering from the full screen breadt Greatest care should be taken during sampling, transport for further processing, quartering, and test screening that the formation of smaller pieces is avoided.

Quartering of samples for test screening is only recommended with grains below 18 mm. (0.7 inches). If the granulation is coarser, test screening of the whole, i. e., not quartered, sample quantity is specified.

Samples below 18 mm. are to be quartered in a suitable manner to the test-screening quantities named above. The prescription of DIN 59?11 must be considered. Before quartering, the material is carefully separated, if necessary, into coarse and fine (below 10 mm) particles. For quartering the fine particles, the use of a quartering utensil is recommended. (Rzezacz "Sampling and Sampler", Glückauf, vol. 71, 1935, p. 702; Plessow: "Sampling in Coal Washeries", Bergbau, vol. 50, 1937, p. 411.)

Samples from screening or sifting processes of dry material are examined in the state in which they are taken. Especially humid samples fron nominally dry processes are treated in the same way as wet samples. Samples from wet-screening processes are carefully and tenderly dried in the air or at temperatures of not more than 40° C. until the surface moisture has disappeared and no small grains adhere to coarser grains. Before carrying out a screen analysis, coal sludge must be screened in a wet state or sprayed on a 0.12 mm. screen.

Generated on 2024-09-19 17:24 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

III. Surface Moisture and Its Determination.

In all cases where guarantees are given for a definite surface moisture or are made dependent on it, take special moisture samples of 100 to 200 grams each to be used for test. They are closed tight to air at once.

The determination of the surface moisture is usually carried out by 3 hours' drying at 40° C. in a drier. The height of bed of the samples of fine and finest grains shall not surpass 10 or 3 mm. (0.39 or 0.11 inch), respectively. Wet samples should not be examined simulataneously in the same drier.

IV. Carrying Out Test Screening.

Test screening is carried out in a different way, according to the grain size of the sample. It is restricted to the determination of the exactness of the grain separation and so does not refer to a checking of the dispersion of the grain within the normal grain limits.

Above 1 mm., round-punched screens are to be used, the opening width of which has exactly to correspond to the fixed grain limits. In washed nut coals, the width is uniform through all the Reich 80, 50, 30, 18, 10, and 6 mm. (3.1, 1.9, 1.2, 0.7, 0.39, and 0.24 inch).

(a) For grains of a size equal to 18 mm. (0.7 inch) or over 18 mm., the test sieving is made by hand on a fixed sieve plate. To avoid grinding, the test sieve is to be used only as gage for the dubious or obvious false-grain (stick-through method).

(b) For grains of size under 18 mm., test sieving is made on a hand sieve. Test sieving of grain smaller than 1 mm. is accomplished according to DIN 53705.

Round-punched sieves according to DIN 1170 are employed also for the medium grain of a size of 18 to 6 mm. (0.7 to 0.14 inch), and for fine grain down to 1 mm., inclusive.

In case of finest grain, however, use test screens with standard square-mesh fabrics according to DIN 1171. For test sieving of fine grain under 10 mm. (0.39 inch) and of finest grain, it is recommended to apply uniformly the following sieve grades:

Sieves according to DIN 1170 with round openings	10.0 mm.	(5.0) mm.
	8.0 mm.	(3.0) mm.
	6.0 mm.	(2.0) mm.
		1.0
Sieve fabric according to DIN 1171 with mesh widths in the clear as follows:	0.75 mm.	(0.12) mm.
	0.5 mm.	0.09 mm.
	0.3 mm.	(0.075)mm.
	(0.2) mm.	0.060 mm.

Generated on 2024-09-19 17:23 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

V. Evaluation and False Grain Determination.

In testing grains over 6 mm. (0.24 inch), a piece is to be regarded as undergrain only if all its measurements are smaller than the opening of the test sieve, and as overgrain only when at least two measurements are greater than the opening of the test sieve. Therefore, at a test sieving of Steinkohle, a needle grain belongs into the grain class in which it is found at the time of sampling, and therefore should be figured into the normal grain. As this determination is for grain under 18 mm., it runs into practical difficulties, so that the sieve through flow shall be resieved with an approximately 20 percent smaller sieve, and the then remaining residue will be figured with the normal grain.

In case of grain under 6 mm. (0.24 inch), the result of the test sieving is directly decisive. Needle grain need not be determined and recounted.

This manner of testing may result in a higher content of false grain than is the fact. The same is valid for the test sieving of fine, dedusted coal. Allowance for this possibility must be made when fixing the tolerances for false grain.

VI. Valuation of the Sifting Results.16/

It is not advisable, in sifting, to fix a guarantee for dust output, sifting quality, or efficiency and to determine these figures by calculation. It is recommended, rather, that sifting success be judged merely according to the determined amount of misgrain.

16/ See Glückauf, vol. 69, 1933, p. 957.

Generated on 2024-09-19 17:29 GMT / https://hdl.handle.net/2027/osu.32435030643845
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY